

**PROJECT MANUAL CONSTRUCTION DOCUMENTS**

# **St. Augustine HS Wellness Center Renovation**

2600 A.P. Tureaud Ave. New Orleans, LA 70119

May 26, 2023

## **Woodward Design+Build**

New Orleans, LA

[www.woodwarddesignbuild.com](http://www.woodwarddesignbuild.com)

## **TRAPOLINPEER**

Trapolin-Peer Architects

New Orleans, Louisiana

[www.trapolinpeer.com](http://www.trapolinpeer.com)

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## SECTION 000110 – TABLE OF CONTENTS

## DIVISION 00 – PROJECT INFORMATION

000101	Project Title Page
000110	Table of Contents

## DIVISION 01 - GENERAL REQUIREMENTS

012500	Substitution Procedures
013300	Submittal Procedures
013516	Alteration Project Procedures
014000	Quality Requirements
014200	References
016000	Product Requirements
017100	Site Preparation (SE)
017300	Execution
017413	Progress and Final Cleaning
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
017900	Demonstration and Training
018113	Sustainable Design Requirements – Non-Certified Project

## DIVISION 02 - EXISTING CONDITIONS

024113	Selective Site Demolition (SE)
024119	Selective Demolition

## DIVISION 03 – CONCRETE

030130	Maintenance of Cast-in-place Concrete
031100	Concrete Formwork (SE)
032000	Concrete Reinforcement (SE)
033000	Cast-in-place Concrete (SE)
035413	Gypsum Cement Underlayment
035416	Hydraulic Cement Underlayment

## DIVISION 04 - MASONRY

040110	Masonry Cleaning
040120.63	Brick Masonry Repair
042000	Unit Masonry
042200	Concrete Unit Masonry (SE)

## DIVISION 05 – METALS

051200	Structural Steel (SE)
052100	Steel Joists (SE)
053100	Steel Deck (SE)
054000	Cold Formed Metal Framing (SE)
055000	Metal Fabrications
055213	Pipe and Tube Railings, Interior
057100	Decorative Metal Stairs
057311	Decorative Metal Railings, Interior
057313	Glazed Decorative Metal Railings, Glass Infill

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

- 061053 Miscellaneous Rough Carpentry
- 061600 Sheathing
- 064023 Interior Architectural Woodwork

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

- 071616 Crystalline Waterproofing
- 071900 Water Repellents
- 072100 Thermal Insulation
- 072726 Fluid-Applied Membrane Air Barriers, Vapor Permeable
- 074215 Metal Composite Material Wall Panels
- 074646 Fiber-Cement Siding and Soffits
- 075216 SBS Modified Bituminous Membrane Roofing
- 076200 Sheet Metal Flashing and Trim
- 077200 Roof Accessories
- 078413 Penetration Firestopping
- 078446 Fire-resistive Joint Systems
- 079200 Joint Sealants
- 079219 Acoustical Joint Sealants

DIVISION 08 – OPENINGS

- 081113 Hollow Metal Doors and Frames
- 081416 Flush Wood Doors
- 083113 Access Doors and Frames
- 083313 Coiling Counter Doors
- 084113 Aluminum-framed Entrances and Storefronts
- 085113 Aluminum Windows
- 087100 Door Hardware
- 088000 Glazing
- 088300 Mirrors
- 089119 Fixed Louvers

DIVISION 09 – FINISHES

- 090160 Maintenance of Terrazzo
- 092116 Gypsum Board Shaft Wall Assemblies
- 092216 Non-structural Metal Framing
- 092400 Cement Plastering
- 092900 Gypsum Board
- 093013 Ceramic Tiling
- 095113 Acoustical Panel Ceilings
- 095133 Acoustical Metal Pan Ceilings
- 096253 Synthetic Turf Flooring
- 096466 Wood Athletic Flooring
- 096513 Resilient Base and Accessories
- 096519 Resilient Tile Flooring
- 096566 Resilient Athletic Flooring
- 096723 Resinous Flooring
- 096813 Tile Carpeting
- 097814 FRP Interior Wall Paneling
- 098433 Sound-Absorbing Wall Units
- 099113 Exterior Painting
- 099125 Interior Painting and Repainting

099600 High-performance Coatings

DIVISION 10 - SPECIALTIES

101100 Visual Display Units  
 101419 Dimensional Letter Signage  
 101423 Panel Signage  
 102113 Phenolic-core Toilet Compartments  
 102239 Folding Glass Panel Partitions  
 102600 Wall and Door Protection  
 102800 Toilet, Bath, and Laundry Accessories  
 104413 Fire Protection Cabinets  
 104416 Fire Extinguishers  
 105100 Lockers  
 107119 Flood Control Barriers

DIVISION 11 – EQUIPMENT

113013 Residential Appliances  
 116623 Gymnasium Equipment  
 116643 Interior Scoreboards

DIVISION 12 - FURNISHINGS

122413 Roller Window Shades  
 123216 Manufactured Plastic-laminate-clad Casework  
 123616 Metal Countertops  
 123663 Solid Surfacing Countertops  
 126600 Telescoping Stands

DIVISION 14 - CONVEYING EQUIPMENT

142123 Machine Room-less Electric Traction Passenger Elevators

DIVISION 21 - FIRE SUPPRESSION

210000 Sprinkler General Requirements  
 210500 Sprinkler Basic Materials  
 210513 Common Motor Requirements for Fire Suppression Equipment  
 210553 Identification for Fire-Suppression Equipment  
 211119 Fire Department Connections  
 211313 Wet-Pipe Sprinkler Systems  
 213113 Electric-Drive, Centrifugal Fire Pumps  
 213400 Pressure Maintenance Pumps

DIVISION 22 – PLUMBING

220000 Plumbing General Requirements  
 220500 Plumbing Basic Materials and Methods  
 220513 Common Motor Requirements for Plumbing Equipment  
 220523 General Duty Valves for Plumbing Piping  
 220529 Hangers and Supports for Plumbing Piping and Equipment  
 220719 Plumbing Piping Insulation  
 221116 Domestic Water Piping  
 221119 Domestic Water Piping Specialties  
 221316 Sanitary Waste and Vent Piping  
 221319 Sanitary Waste Piping Specialties  
 221413 Storm Drainage Piping

221423	Storm Drainage Piping Specialties
221449	Natural Gas Piping
223400	Fuel-Fired, Domestic-Water Heaters
224000	Plumbing Fixtures
DIVISION 23 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)	
230000	HVAC General Requirements
230500	Basic Materials and Methods
230514	Enclosed Controllers
230515	Variable Frequency Controllers
230517	Sleeves and Sleeve Seals for HVAC Piping
230519	Meters and Gauges for HVAC Piping
230523	Valves
230529	Hangers and Supports for HVAC Piping and Equipment
230548	Mechanical Vibration Controls
230553	Mechanical Identification
230593	Testing, Adjusting, and Balancing for HVAC
230713	Duct Insulation
230719	HVAC Piping Insulation
230800	HVAC Functional Check Out
230923	Direct Digital Control System
231123	Facility Natural-Gas Piping
232300	Refrigerant Piping
233113	Metal Ducts
233300	Duct Accessories
233423	Power Ventilators
233713	Diffusers, Registers and Grilles
235100	Breechings, Chimneys and Stacks
237416	Single Zone Heat Pump Rooftop Air-Conditioning Units
237433	Dedicated Outdoor-Air Units
238126	Split-System Heat Pump Units
239126	Packaged Rooftop Air-Conditioners
DIVISION 26 ELECTRICAL	
260010	Electrical General Provisions
260020	Basic Electrical Materials and Methods
260519	Low-Voltage Electrical Power Conductors and Cables
260526	Grounding and Bonding for Electrical Systems
260533	Raceway and Boxes for Electrical Systems
260553	Identification for Electrical Systems
260573.13	Short-Circuit Studies
260573.16	Coordination Studies
260573.19	Arc-Flash Hazard Analysis
260923	Lighting Control Devices
260943.23	Relay Based Lighting Controls
262416	Panelboards
262726	Wiring Devices
262813	Fuses
262816	Enclosed Switches and Circuit Breakers
265100	Interior Lighting

DIVISION 27 COMMUNICATIONS  
271100 Communications Equipment Room Fittings  
271300 Communications Backbone Cabling  
271500 Communications Horizontal Cabling

DIVISION 28 ELECTRONIC SAFETY AND SECURITY  
283111 Digital Addressable Fire-Alarm System

DIVISION 31 EARTHWORK (SE)  
312001 Earthwork  
312316 Excavation  
312323 Fill and Backfill  
312333 Trenching for Site Utilities  
312500 Erosion and Sediment Controls

DIVISION 32 EXTERIOR IMPROVEMENTS (SE)  
321313 Concrete Paving (SE)  
321400 Unit Paving (LA)  
321613 Curbs and Gutters (SE)  
321623 Sidewalks (SE)  
329200 Turfgrasses (LA)  
329300 Planting (LA)

DIVISION 33  
331600 Underground Storm Drainage Tanks (LA)  
334100 Storm Utility Drainage Piping (LA)

END OF TABLE OF CONTENTS

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## SECTION 012500 - SUBSTITUTION PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

## 1.2 DEFINITIONS

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

## 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form provided in Project Manual, form that is part of web-based Project management software, or other form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication, or installation method cannot be provided, if applicable.
    - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.
    - f. Certificates and qualification data, where applicable or requested.

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

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 PROCEDURES

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

#### 1.6 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with sustainable design requirements.
  - c. Substitution request is fully documented and properly submitted.
  - d. Requested substitution will not adversely affect Contractor's construction schedule.
  - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - f. Requested substitution is compatible with other portions of the Work.
  - g. Requested substitution has been coordinated with other portions of the Work.
  - h. Requested substitution provides specified warranty.
  - i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
    - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
    - b. Requested substitution does not require extensive revisions to the Contract Documents.
    - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - d. Requested substitution provides sustainable design characteristics that specified product provided for compliance with sustainable design requirements.
    - e. Substitution request is fully documented and properly submitted.
    - f. Requested substitution will not adversely affect Contractor's construction schedule.
    - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - h. Requested substitution is compatible with other portions of the Work.
    - i. Requested substitution has been coordinated with other portions of the Work.
    - j. Requested substitution provides specified warranty.
    - k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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## SECTION 013300 - SUBMITTAL PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

## 1.2 DEFINITIONS

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

## 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
  1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
  4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal Category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.
    - g. Scheduled dates for purchasing.
    - h. Scheduled date of fabrication.

- i. Scheduled dates for installation.
- j. Activity or event number.

#### 1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

#### 1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
  - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
    - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

#### 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  - 2. Mark each copy of each submittal to show which products and options are applicable.
  - 3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
  - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
  - 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.



2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
  - a. Project name and submittal number.
  - b. Generic description of Sample.
  - c. Product name and name of manufacturer.
  - d. Sample source.
  - e. Number and title of applicable Specification Section.
  - f. Specification paragraph number and generic name of each item.
3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
  - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set(s) 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. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software, as applicable. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
  1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
  - 2. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## SECTION 013516 - ALTERATION PROJECT PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes special procedures for alteration work.

## 1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's pre-bid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep existing items that are not to be removed or dismantled.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

## 1.3 COORDINATION

- A. Alteration Work Sub-schedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.

1. Schedule construction operations in sequence required to obtain best Work results.

2. Coordinate sequence of alteration work activities to accommodate the following:
    - a. Owner's continuing occupancy of portions of existing building.
    - b. Owner's partial occupancy of completed Work.
    - c. Other known work in progress.
    - d. Tests and inspections.
  3. Detail sequence of alteration work, with start and end dates.
  4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
  5. Use of elevator and stairs.
  6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
- B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Plan and execute the Work accordingly.

#### 1.4 PROJECT MEETINGS FOR ALTERATION WORK

- A. Preliminary Conference for Alteration Work: Before starting alteration work, Architect will conduct conference at Project site.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
  2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
    - a. Alteration Work Sub-schedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
    - b. Fire-prevention plan.
    - c. Governing regulations.
    - d. Areas where existing construction is to remain and the required protection.
    - e. Hauling routes.
    - f. Sequence of alteration work operations.
    - g. Storage, protection, and accounting for salvaged and specially fabricated items.
    - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
    - i. Qualifications of personnel assigned to alteration work and assigned duties.
    - j. Requirements for extent and quality of work, tolerances, and required clearances.
    - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
  3. Reporting: Architect will record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
  2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
    - a. Alteration Work Sub-schedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
    - b. Schedule Updating: Revise Contractor's Alteration Work Sub-schedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
      - 1) Interface requirements of alteration work with other Project Work.
      - 2) Status of submittals for alteration work.
      - 3) Access to alteration work locations.
      - 4) Effectiveness of fire-prevention plan.
      - 5) Quality and work standards of alteration work.
      - 6) Change Orders for alteration 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.

#### 1.5 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed at Project site.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Alteration Work Sub-schedule:
1. Submit alteration work sub-schedule as part of requirements for Section 013200 "Construction Progress Documentation."

- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit 30 days before work begins.
- D. Fire-Prevention Plan: Submit 30 days before work begins.

#### 1.7 QUALITY ASSURANCE

- A. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
  - 1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
  - 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

#### 1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
  - 1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
  - 2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area on-site.
  - 5. Protect items from damage during transport and storage.
- B. Salvaged Materials for Reinstallation:
  - 1. Repair and clean items for reuse as indicated.
  - 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
  - 3. Protect items from damage during transport and storage.



4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
  - D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
    1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
    2. Secure stored materials to protect from theft.
    3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.
  - E. Storage Space:
    1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space [includes] [does not include] security [ and climate control] for stored material.
    2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.
- 1.9 FIELD CONDITIONS
- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of preconstruction photographs.
    1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
  - C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner that the following items have been removed:
    1. <Insert items to be removed by Owner>.
  - D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

## PART 2 - PRODUCTS - (Not Used)

## PART 3 - EXECUTION

## 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
1. Use only proven protection methods, appropriate to each area and surface being protected.
  2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
  3. Erect temporary barriers to form and maintain fire-egress routes.
  4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
  5. Contain dust and debris generated by alteration work and prevent it from reaching the public or adjacent surfaces.
  6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
  7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
  8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
  2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
  2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
  3. Maintain existing services unless otherwise indicated; keep in service and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
  2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

- F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

### 3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties titled "Owner's Responsibility for Fire Protection."
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
  - a. If combustible material cannot be removed, provide fire blankets to cover such materials.

- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
  - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
  - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
  - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
  - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
  - e. Maintain fire-watch personnel at each area of Project site until two hours after conclusion of daily work.

- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.
  - 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

### 3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

### 3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
  - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION

## SECTION 014000 - QUALITY REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
  - 1. Section 012100 "Allowances" for testing and inspection allowances.

## 1.2 DEFINITIONS

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

1. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
  2. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

### 1.3 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

### 1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict

and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports and documents as specified.
- E. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

#### 1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.



## 13. Recommendations on retesting and re-inspecting.

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical 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 operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

## 1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the

system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

- F. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
  - 1. Provide test specimens representative of proposed products and construction.
  - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
  - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
  - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
  - 5. When testing is complete, remove test specimens and test assemblies, and temporary mockups; do not reuse products on Project.
  - 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups of size indicated.
  - 2. Build mockups in location indicated or, if not indicated, as directed by Architect.
  - 3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
  - 5. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

#### 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Payment for these services will be made from testing and inspection allowances specified in Section 012100 "Allowances," as authorized by Change Orders.
  3. Costs for retesting and re-inspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.

2. Distribution: Distribute schedule to Owner, Architect testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections included in the Contract Documents, and as follows:
  1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  6. Retesting and re-inspecting corrected Work.

#### PART 2 - PRODUCTS (Not Used)

#### PART 3 - EXECUTION

##### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.
  1. Submit log at Project closeout as part of Project Record Documents.

##### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

## SECTION 014200 - REFERENCES

## PART 1 - GENERAL

## 1.1 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. "Day." The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.
- D. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- E. "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."
- F. "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.
- G. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- H. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- I. "Provide": Furnish and install, complete and ready for the intended use.
- J. "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.

## 1.2 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.
  - 1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

- C. Copies of Standards: Each entity engaged in construction on Project should 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.

### 1.3 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's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; [www.din.de](http://www.din.de).
  2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
  3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
  4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).
- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
  2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
  3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
  4. DOD - Department of Defense; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
  6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
  7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
  8. FG - Federal Government Publications; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
  9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
  10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).
  11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; [www.eetd.lbl.gov](http://www.eetd.lbl.gov).
  12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  13. SD - Department of State; [www.state.gov](http://www.state.gov).
  14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
  15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
  18. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
  19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).



- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.govinfo.gov](http://www.govinfo.gov).
  2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  3. DSCC - Defense Supply Center Columbus; (See FS).
  4. FED-STD - Federal Standard; (See FS).
  5. FS - Federal Specification; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
  6. MILSPEC - Military Specification and Standards; (See DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
  2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
  3. CDHS; California Department of Health Services; (See CDPH).
  4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cal-iaq.org](http://www.cal-iaq.org).
  5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
  6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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## SECTION 016000 - PRODUCT REQUIREMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.

## 1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
  - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
  - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the

specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
  - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
  - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

### 1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. Resolution of Compatibility Disputes between Multiple Contractors:
    - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
  - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
    - a. Name of product and manufacturer.
    - b. Model and serial number.
    - c. Capacity.
    - d. Speed.
    - e. Ratings.
  - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

## 1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

## 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

- B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

- C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
    - b. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
  3. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
    - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of an unnamed product is not considered a substitution if the product complies with requirements.
  4. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.
    - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
  5. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
    - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
  6. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
    - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product match.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
  1. Select products for which sustainable design documentation submittals are available from manufacturer.
  2. In addition to specific sustainable design requirements, provide products with the maximum amount possible of post-consumer and pre-consumer recycled content.
  3. In addition to specific sustainable design requirements, provide products manufactured and extracted within 100 miles of the project site whenever possible.
  4. In addition to specific sustainable design requirements, provide products manufactured and extracted within 100 miles of the project site whenever possible.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:
  1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.
- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
  1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.



- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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## SECTION 017100 - SITE PREPARATION

### PART 1 - GENERAL

#### 1.1 SCOPE OF WORK

- A. Furnish all labor, materials, and equipment required and perform all site preparation; complete as shown on the Drawings, as required and as specified herein.
- B. Clear, grub, and strip areas actually needed for waste disposal, borrow, or site improvements within limits shown, specified or as required for this Work and acceptable to the Engineer.
- C. Do not injure or deface vegetation that is not designated for removal.
- D. Refer to Division 01 Specifications, and the Drawings for additional requirements related to Site Preparation.

#### 1.2 DEFINITIONS

- A. Clearing: Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, roots in excess of 1-1/2-in diameter, matted roots, brush, timber, concrete rubble, and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of foundations, whichever is deeper.
- C. Scalping: Removal of sod without removing more than upper 3-in of topsoil.
- D. Stripping: Removal of topsoil remaining after applicable scalping is completed.
- E. Project Limits: Areas, as shown or specified, within which work is to be performed.

#### 1.3 QUALITY ASSURANCE

- A. Obtain Engineer's approval of staked limits for all work under this Section prior to commencing this portion of the Work.

#### 1.4 SCHEDULING AND SEQUENCING

- A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 0.5 acres.

#### 1.5 LIMITS

- A. Clearing, grubbing, scalping, and stripping (unless noted otherwise) shall be performed to the following limits, but shall not extend beyond adjacent structures (provide structure protection as noted elsewhere in the Contract Documents and as acceptable to the Engineer) or the project limits.

1. Excavation Excluding Trenches: 5-ft beyond top of cut slopes.
2. Trench Excavation: 10-ft on either side of trench centerline, regardless of actual trench width, or 2-ft beyond the top of trench excavation, whichever is greater.
3. Fill Areas: 5-ft beyond toe of permanent fill
4. Waste Disposal:
5. Clearing: 5-ft beyond perimeter.
6. Scalping and Stripping: Not required.
7. Grubbing: Around perimeter as necessary for neat finished appearance.
8. Structures: 15-ft outside of new structures.
9. Roadways: 10-ft from toe of fill or top of cut.
10. Overhead Utilities, Clearing, and Grubbing: Entire width of easements/ rights-of-way or construction area, whichever is greater.
11. Wherever grading is required: to 2-ft beyond grading limits, unless a larger dimension is specified or shown for specific activities.
12. Remove rubbish, trash, and junk from entire area within project limits.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.1 CLEARING

- A. Preserve and protect trees and other vegetation unless otherwise designated on the Drawings to be removed. Trees located within the site fencing shall be preserved, protected, and relocated.

### 3.2 GRUBBING

- A. See paragraph 1.2, Definitions.

### 3.3 SCALPING

- A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.
- B. Scalp areas within limits shown, specified or required for the Work.

### 3.4 STRIPPING

- A. Do not remove topsoil until after scalping is completed.
- B. Strip areas within limits to minimum depth shown, specified or required for the Work. Do not remove subsoil with topsoil.
- C. Stockpile strippings separately from other excavated material.

### 3.5 DISPOSAL

- A. Clearing and Grubbing Debris:
  1. Dispose of debris offsite.
  2. Burning of debris onsite will not be allowed.

3. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities. Offsite disposal shall not be visible from project.
- B. Scalpings: Disposal shall be as specified for clearing and grubbing debris.
- C. Strippings:
  1. Properly dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil offsite.
  2. Stockpile topsoil in sufficient quantity to meet project needs. Dispose of excess strippings as specified for clearing and grubbing.

### 3.6 PROTECTION

- A. Maintain protection until all work in the vicinity of the Work being protected has been completed.
- B. Do not operate heavy equipment or stockpile materials within 5-ft of the branch spread ("drip line") of existing trees.
- C. Restrict construction activities to those areas within the limits of construction designated on the Drawings. Adjacent properties and improvements thereon, which become damaged by construction operations, shall be promptly restored to their original condition, as acceptable to the affected property owners or the improvements of the Owner.

### 3.7 TREE REMOVAL OUTSIDE CLEARING LIMITS

- A. Remove within Project Limits:
  1. Dead, dying, leaning, or otherwise unsound trees that may strike and damage project facilities in falling, and as acceptable to the Engineer.
  2. Designated trees.
- B. Cut stumps off flush with ground, remove debris, and if disturbed, restore surrounding area to its original condition.

END OF SECTION 017100

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## SECTION 017300 - EXECUTION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Installation of the Work.
  - 3. Cutting and patching.
  - 4. Starting and adjusting.
  - 5. Protection of installed construction.
  
- B. Related Requirements:
  - 1. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
  - 2. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

## 1.2 DEFINITIONS

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

## 1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
  - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
    - a. Contractor's superintendent.
    - b. Trade supervisor responsible for cutting operations.
    - c. Trade supervisor(s) responsible for patching of each type of substrate.
    - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
  
  - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.4 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
  3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.



- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  - 1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  - 2. List of detrimental conditions, including substrates.
  - 3. List of unacceptable installation tolerances.
  - 4. Recommended corrections.
- D. 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, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

### 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 and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

- C. 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.

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- 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 satisfactory results as judged by Architect. 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 of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with

integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

### 3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side 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 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.
- H. 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 practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place 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 and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.7 STARTING AND ADJUSTING
- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
  - B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
  - 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: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION AND REPAIR 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. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

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## SECTION 017413 – PROGRESS AND FINAL CLEANING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for progress cleaning and final cleaning.

## 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Cleaning Products: Indicate compliance with quality assurance requirements.
  - 2. Disinfectants, Metal Polish, Floor Finishes, and Strippers: Indicate compliance with quality assurance requirements.
- B. Product Application Schedule: Schedule of cleaning products indicating application for each type of product.
- C. Equipment Data: Indicate equipment used for final cleaning complies with quality assurance requirements.
- D. Final Cleaning Program: Description of cleaning procedures and product applications for final cleaning for each type of room, surface and material.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Inspection Reports: For pest control final inspection.

## 1.4 QUALITY ASSURANCE

- A. Product Requirements:
  - 1. Cleaning Products: Comply with Green Seal GS-37.
  - 2. Disinfectants, Metal Polish: Comply with Green Seal GS-40.
  - 3. Floor Finishes, and Strippers: Comply with Green Seal GS-40.
- B. Worker Qualifications: Provide cleaning services performed by experienced firm specializing in cleaning of new construction of similar type and scope, employing workers trained by suppliers of products and equipment utilized in progress and final cleaning.
- C. Equipment Certification: Perform final cleaning utilizing vacuum equipment certified under Carpet and Rug Institute Green Label program, equipped with HEPA filters.
- D. Final Cleaning Standard: Clean facility to APPA Appearance Level 1 in APPA *Custodial Staffing Guidelines for Educational Facilities*.

## 1.5 COORDINATION

- A. Floor Finish Scheduling: Schedule application of multiple coat floor finish application with CMS representative to coordinate work with Owner installation of furniture.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Materials, General: Do not introduce cleaning agents, disinfectants, metal polishes, floor strippers, or other products into the facility that are not listed on approved product application schedule.
- B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Unless otherwise indicated, use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
- C. Disinfectants, Metal Polishes, and Other Products: Use materials and agents recommended by manufacturer or fabricator of the affected surface. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Unless otherwise indicated, use cleaning products that meet Green Seal GS-40, or if GS-40 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.
- D. Floor Stripper and Sealer Products: Use materials and agents recommended by manufacturer or fabricator of the affected surface. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use Owner's stipulated products, or if not stipulated by Owner, submit product data for products meeting requirements of this Section and approved in writing by flooring manufacturer.

## PART 3 - EXECUTION

## 3.1 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Utilize containers intended for holding waste materials of type to be stored.
- 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls"
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

### 3.2 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations. Leave Project clean and ready for occupancy.
- B. Cleaning: Clean each surface or unit to quality level specified. Comply with product manufacturer's and equipment manufacturer's written instructions.
- C. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
1. Project Site
    - 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, wash walkways 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. Remove snow and ice to provide safe access to building.
  2. Building Exterior and Interior

- a. 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.
  - b. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - c. 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.
  - d. Remove labels that are not permanent.
  - e. 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.
  - f. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint from surface to provide intended readability.
3. Building Interior
- a. Clean and disinfect plumbing fixtures, vanity tops, and countertops to a sanitary condition, free of stains, including stains resulting from water exposure.
  - b. Move and reset Owner's furniture, fixtures, and equipment as required to complete cleaning Work. Clean furniture, fixtures, and equipment that have become soiled following Owner's installation.
4. Equipment and Systems
- a. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - b. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - c. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - d. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection. Coordinate of ductwork with other closeout procedures.
  - e. 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.
- D. Floor Cleaning and Finishing:
1. Thoroughly clean building surfaces using approved equipment.
  2. VCT Flooring: Sweep, mop, strip, wax, and buff flooring in accordance with floor wax product manufacturer's recommendations.
    - a. Apply wax at 3-micron dry film thickness per coat.
    - b. Rooms: Strip and apply three coats of wax and buff.

- c. Corridors: Apply first two coats of wax prior to Owner's setting furniture in rooms. Following setting of furniture, apply additional final three coats of wax and buff.
  3. Hard Tile Flooring: Scrub mop. Do not apply wax to hard tile flooring.
  4. Carpet: Vacuum carpet, removing debris and excess nap.
    - a. Vacuum carpet using approved vacuum equipment.
    - b. Clean new carpet using steam extraction method if visible soil or stains remain.
  5. Concrete Floors: Vacuum and mop sealed concrete floors in unoccupied spaces.
- E. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.
- F. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."
  1. Do not utilize storm drain system for disposal of floor stripping wastewater.

END OF SECTION

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## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.

#### 1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

#### 1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
  5. Submit testing, adjusting, and balancing records.
  6. Submit sustainable design submittals not previously submitted.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. 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.

#### 1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
  5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.8 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
  2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. MS Excel Electronic File: Architect will return annotated file.
    - b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

## 1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 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.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION



## SECTION 017823 - OPERATION AND MAINTENANCE DATA

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

## 1.2 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operation and maintenance submittals is acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.
  - 2. Submit three paper copies. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

## 1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders, if necessary, to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
  4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.
- 1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS
- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.

- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

## 1.5 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

## 1.6 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
  2. Shutdown instructions for each type of emergency.
  3. Operating instructions for conditions outside normal operating limits.
  4. Required sequences for electric or electronic systems.
  5. Special operating instructions and procedures.
- 1.7 SYSTEMS AND EQUIPMENT OPERATION MANUALS
- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor have delegated design responsibility.
  3. Operating standards.
  4. Operating procedures.
  5. Operating logs.
  6. Wiring diagrams.
  7. Control diagrams.
  8. Piped system diagrams.

9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

## 1.8 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.
- 1.9 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## SECTION 017839 - PROJECT RECORD DOCUMENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
1. Record Drawings.
  2. Record specifications.
  3. Record Product Data.
  4. Miscellaneous record submittals.

## 1.2 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
1. Number of Copies: Submit one set(s) of marked-up record prints.
  2. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
      - 3) Submit Record Digital Data Files and one set(s) of plots.
      - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit three paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
      - 3) Print each drawing, whether or not changes and additional information were recorded.
    - c. Final Submittal:
      - 1) Submit one paper-copy set(s) of marked-up record prints.
      - 2) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
      - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

### 1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  4. Refer instances of uncertainty to Architect for resolution.
  5. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file with comment function enabled.
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

#### 1.4 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
  5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

- B. Format: Submit record specifications as [annotated PDF electronic file] [scanned PDF electronic file(s) of marked-up paper copy of Specifications].

#### 1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as [annotated PDF electronic file] [scanned PDF electronic file(s) of marked-up paper copy of Product Data].
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

#### 1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as [PDF electronic file] [scanned PDF electronic file(s) of marked-up miscellaneous record submittals].
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

#### 1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## SECTION 017900 - DEMONSTRATION AND TRAINING

## PART 1 - GENERAL

## 1.1 SUMMARY

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

## 1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

## 1.3 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 1.4 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

#### 1.5 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

- 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

- a. System, subsystem, and equipment descriptions.
- b. Performance and design criteria if Contractor is delegated design responsibility.
- c. Operating standards.
- d. Regulatory requirements.
- e. Equipment function.
- f. Operating characteristics.
- g. Limiting conditions.
- h. Performance curves.

- 2. Documentation: Review the following items in detail:

- a. Emergency manuals.
- b. Systems and equipment operation manuals.
- c. Systems and equipment maintenance manuals.
- d. Product maintenance manuals.
- e. Project Record Documents.
- f. Identification systems.
- g. Warranties and bonds.
- h. Maintenance service agreements and similar continuing commitments.

- 3. Emergencies: Include the following, as applicable:

- a. Instructions on meaning of warnings, trouble indications, and error messages.
- b. Instructions on stopping.
- c. Shutdown instructions for each type of emergency.
- d. Operating instructions for conditions outside of normal operating limits.
- e. Sequences for electric or electronic systems.
- f. Special operating instructions and procedures.

- 4. Operations: Include the following, as applicable:

- a. Startup procedures.
- b. Equipment or system break-in procedures.
- c. Routine and normal operating instructions.
- d. Regulation and control procedures.

- e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.
    - d. Economy and efficiency adjustments.
  6. Troubleshooting: Include the following:
    - a. Diagnostic instructions.
    - b. Test and inspection procedures.
  7. Maintenance: Include the following:
    - a. Inspection procedures.
    - b. Types of cleaning agents to be used and methods of cleaning.
    - c. List of cleaning agents and methods of cleaning detrimental to product.
    - d. Procedures for routine cleaning.
    - e. Procedures for preventive maintenance.
    - f. Procedures for routine maintenance.
    - g. Instruction on use of special tools.
  8. Repairs: Include the following:
    - a. Diagnosis instructions.
    - b. Repair instructions.
    - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    - d. Instructions for identifying parts and components.
    - e. Review of spare parts needed for operation and maintenance.
- 1.6 PREPARATION
- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
  - B. Set up instructional equipment at instruction location.

## 1.7 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
  - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

## 1.8 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION



## SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS – FOR NON-CERTIFIED PROJECTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Non-Certified Project: Section includes general requirements and procedures for compliance with certain sustainable design standards for occupant well-being including Interior Environmental Quality standards. Details of requirements are found in the individual specification Sections.
1. This Section includes requirements for volatile organic compound (VOC) limits for field applications of adhesives, sealants, paints and coatings used for the Project and located inside the weatherproofing system.
- B. Related Sections:
1. Section 017419 "Construction Waste Management and Disposal."
  2. Section 019113 "General Building Commissioning."
  3. Divisions 02 through 33: Sustainable requirements specific to the work of each of these Sections.

## 1.2 REFERENCE STANDARDS

- A. General: Comply with the applicable provisions of the referenced standards except as modified by governing codes and the Contract Documents. Where a recommendation or suggestion occurs in the referenced standards, such recommendation or suggestion shall be considered mandatory. In the event of conflict of referenced standards and this specification or within the standards themselves, the more stringent standard or requirement shall govern.
1. CARB SCM: [California Air Resource Board Suggested Control Measure for Architectural Coatings.](#)
  2. CDPH: [California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version v1.2-2017."](#)
  3. EPA TSDA: [Environmental Protection Agency Toxic Substance Control Act Title VI Compliance Rule, 2016.](#)
  4. GS-11: [Green Seal Paint Standard GS-11.](#)
  5. GS-36: [Green Seal Commercial Adhesive Standard GS-36.](#)
  6. SCAQMD 1113: [South Coast Air Quality Management District Rule 1113.](#)
  7. SCAQMD 1168: [South Coast Air Quality Management District Rule 1168.](#)

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Sustainable Design Coordination Conference: Schedule a sustainable design coordination conference as part of preconstruction conference, at a time convenient to Owner, Architect, and Commissioning Agent.
1. Agenda: Discuss items of significance that could affect complying with requirements for sustainable design certification, including the following:
    - a. General requirements for sustainable design-related procurement including submittal documentation.

- b. Construction waste management.
- c. Construction operations and sustainable design requirements and restrictions.

#### 1.4 ACTION SUBMITTALS

- A. General: Submit sustainable design submittals required by other Specification Sections as part of Product Data submittal. Provide manufacturer's technical information for all applied adhesives, sealants, paints and coatings, and other interior materials indicating VOC content in grams/Liter (g/L), including:
  - 1. Product data indicating compliance with general emissions evaluation and VOC content requirements.
- B. Sustainable Design Documentation Submittals:
  - 1. Sustainable design submittals are part of the normal Project submittal process.
  - 2. Material ingredient reports for products that comply with sustainable design requirements for material ingredient reporting.
  - 3. Product data for adhesives and sealants used inside the weatherproofing system, indicating VOC content and laboratory test reports showing compliance with requirements for low-emitting materials.
  - 4. Product data for paints and coatings used inside the weatherproofing system, indicating VOC content and laboratory test reports or acceptable product data showing compliance with requirements for low-emitting materials.
  - 5. Laboratory test reports or acceptable product data for flooring, indicating compliance with requirements for low-emitting materials.
  - 6. Hard surface flooring products demonstrate compliance with FloorScore.
  - 7. Carpet demonstrate compliance with CRI Green Label Plus.
  - 8. Laboratory test reports or acceptable product data for products containing composite wood or agrifiber products or wood glues, indicating compliance with requirements for low-emitting materials.
  - 9. Laboratory test reports or acceptable product data for ceilings, walls, and thermal insulation, indicating compliance with requirements for low-emitting materials.
  - 10. Construction Indoor Air Quality (IAQ) Management:
    - a. Construction IAQ management plan.
    - b. Product data for temporary filtration media.
    - c. Product data for filtration media used during occupancy.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Construction Indoor-Air-Quality (IAQ) Management:
  - 1. Product data for temporary filtration media.
  - 2. Product data for filtration media used during occupancy.
- B. IAQ Assessment: Not required.

## PART 2 - PRODUCTS

## 2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary satisfy sustainable design requirements indicated as Contractor's responsibility. Although other Sections may specify some requirements that contribute to satisfying sustainable design requirements, Contractor provides additional materials and procedures necessary to satisfy sustainable design requirements indicated.

## 2.2 LOW-EMITTING MATERIALS

- A. **Adhesives and Sealants:** For field applications of field-applied adhesives, adhesive bonding primers, and adhesive primers that are inside the weatherproofing system, including flooring adhesive, 75 percent of adhesives and sealants meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.
1. **VOC Content:** For field applications that are inside the weatherproofing system, provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of SCAQMD 1168.
- B. **Paints and Coatings:** For field applications that are inside the weatherproofing system, 75 percent of paints, coatings, and primers meet the VOC emissions evaluation and 100 percent meet the VOC content evaluations.
1. **VOC Content:** For field applications that are inside the weatherproofing system, provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CARB SCM or SCAQMD 1113.
  2. Added Methylene chloride and perchloroethylene is not permitted.
- C. **Composite Wood:** A minimum of 75 percent of all composite wood meet the formaldehyde emissions evaluation. Composite wood materials include particleboard, MDF, hardwood veneer plywood, and structural composite wood.
1. Provide product data stating compliance with CARB ATCM or EPA TSCA.
- D. **Flooring:** A minimum of 90 percent of flooring products meet the VOC emissions evaluation or inherently non-emitting sources criteria. Subflooring is included under Wood.
1. **VOC Content:** Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.
- E. **Walls:** A minimum of 75 percent of wall panel products meet the VOC emissions evaluation or inherently non-emitting sources criteria. Wall panel products include wall paneling, wall coverings, wall tile, surface wall structures, cubicle/curtain/partition walls, trim, doors, frames, windows, and window treatments. Removable/interchangeable fabric panels, built-in cabinetry, and vertical structural elements are excluded.
1. **VOC Content:** Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.

- F. **Ceilings:** A minimum of 90 percent of ceilings meet the VOC emissions evaluation or inherently non-emitting sources criteria. Ceiling products include ceiling panels, ceiling tile, surface ceiling structures, suspended systems, and glazed skylights. Overhead structural elements are excluded.
  - 1. **VOC Content:** Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.
  
- G. **Insulation:** A minimum of 75 percent of insulation products meet the VOC emissions evaluation. Insulation products include all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, and foamed-in-place, loose-fill, blown, and sprayed insulation. HVAC duct and plumbing piping insulation are excluded.
  - 1. **VOC Content:** Provide product data stating TVOC content in grams per Liter (d/L) that comply with VOC content limits of CDPH and specified VOC content limits.
  
- H. **Foam Insulation:** Provide foam insulation with fire retardants that contain no hexabromocyclododecane (HBCD) flame retardants. Use Polymeric flame retardants (PolyFR) in lieu of these products.

2.3 ADHESIVES AND SEALANTS VOC LIMITS (SCAQMD 1168 g/L)

A. Architectural Adhesives:

- 1. Building Envelope Membrane Adhesive 250
- 2. Indoor carpet adhesive 50
- 3. Carpet Pad Adhesive 50
- 4. Wood Flooring Adhesive 100
- 5. Rubber Floor Adhesive 60
- 6. Subfloor adhesive 50
- 7. Ceramic Tile Adhesive 65
- 8. VCT and asphalt tile adhesive 50
- 9. Drywall and panel adhesive 50
- 10. Cove base adhesive 50
- 11. Multipurpose construction adhesive 70
- 12. Structural glazing adhesive 100

B. Specialty Adhesives:

- 1. PVC welding 510
- 2. CPVCwelding 490
- 3. ABS welding 325
- 4. All other plastic welding cements 250
- 5. Adhesive primer for plastic 550
- 6. Contact Adhesive 80
- 7. Special Purpose Contact Adhesive 250
- 8. Adhesive Primer for Traffic Marking Tape 150
- 9. Structural Wood Member Adhesive 140
- 10. Top and trim adhesive 250

C. Substrate Specific Adhesives:

- 1. Metal to metal 30

- 2. Plastic foams 50
- 3. Porous material (except wood) 50
- 4. Wood 30
- 5. Fiberglass 80
- 6. Reinforced Plastic Composite 250

D. Other Adhesives

- 1. Other adhesives 250
- 2. Adhesive bonding primers 250
- 3. Adhesive primers, or any other primers 250

E. Sealants:

- 1. Clear, Paintable, and Water-Resistant Sealant 280
- 2. Foam insulation and sealant 250
- 3. Grout Sealant 65
- 4. Non-Staining Plumbing Putty 150
- 5. Potable Water Sealant 100
- 6. Single Ply Roof Membrane Sealants 450
- 7. Other Roof Sealants 300
- 8. All other Architectural Sealants 250
- 9. All other Sealants 420

F. Sealant Primers:

- 1. Architectural - Nonporous 250
- 2. Architectural- Porous 775
- 3. Modified Bituminous 500
- 4. Other 750

2.4 PAINTS AND COATINGS VOC LIMITS (CARB SCM or SCAQMD 1113 g/L)

A. Architectural Paints

- 1. Flat 50
- 2. Non-Flat 100
- 3. Non-Flat High Gloss Coatings 150

B. Coatings:

- 1. Concrete/Masonry Sealers 100
- 2. Fire resistive Coatings 350
- 3. Floor coatings 100
- 4. Low-Solids Coatings 120
- 5. Primers, Sealers, and Undercoaters 100
- 6. Rust Preventative Coatings 250
- 7. Wood Coatings 275
- 8. Clear Wood Finish:
- 9. Varnish 275
- 10. Sanding Sealers 275
- 11. Lacquer 275

- 12. Concrete-Curing Compounds 100
- 13. Dry Fog Coatings 50
- 14. Floor Coatings 50
- 15. Low-solids Coatings 120
- 16. Magnesite Cement Coatings 450
- 17. Primers, Sealers and Undercoaters 100
- 18. Shellac
- 19. Clear 730
- 20. Pigmented 550
- 21. Stains 100
- 22. Waterproofing Sealers 100
- 23. Waterproofing Concrete/Masonry Sealers 100
- 24. Wood Preservatives 350

### PART 3 - EXECUTION

#### 3.1 NONSMOKING BUILDING

- A. Smoking is not permitted on the Project site.

#### 3.2 CONSTRUCTION IAQ MANAGEMENT

- A. Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3."
  - 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  - 2. Replace all air filters immediately prior to occupancy.

END OF SECTION

## SECTION 024113 – SELECTIVE SITE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alterations purposes.
- C. Abandonment and removal of existing utilities and utility structures only as required.

#### 1.2 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2004.

#### 1.3 SUBMITTALS

- A. See Section 013300 – Submittal Procedures
- B. Site Plan: Showing:
  - 1. Areas for temporary construction and field offices.
  - 2. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
  - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

#### 1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
  - 1. Minimum of 5 years of experience.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. None required in this section

### PART 3 - EXECUTION

#### 3.1 SCOPE

- A. This work consists of removal and satisfactory disposal of pavements, sidewalks, curbs, gutters and other obstructions not designated or permitted to remain, except obstructions to be

removed under other contract items. It shall also include salvaging of designated materials and backfilling resulting trenches, holes and pits, except the area to be excavated. At locations where pavement, curbs or gutter, sidewalk, driveway, or footlaps are to be removed but are not to be replaced, the Contractor shall backfill the area with selected excavated or other suitable approved material at no direct payment.

- B. Within area of new construction, remove foundation walls and footings to a minimum of 2 feet below finished grade.
- C. Remove other items indicated, for salvage, relocation, and recycling.

### 3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Provide, erect, and maintain temporary barriers and security devices.
  - 3. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
  - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 5. Do not close or obstruct roadways or sidewalks without permit.
  - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
  - 8. The Contractor shall remove and dispose of all demolished pavements, sidewalks, curbs, gutters and other obstructions.
  - 9. Copies of agreements with property owners shall be furnished to the DPW Director prior to beginning of work.
  - 10. Saw cut may be required prior to removal.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
  - 1. Provide bracing and shoring if structure if needed.
  - 2. Prevent movement or settlement of adjacent structures.
  - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

### 3.3 MEASUREMENTS

- A. When the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the contract.



- B. If the contract does not include pay items for removal of structures and obstructions, the removal work will not be measured for payment.
- C. Hauling salvaged materials to specified storage sites will not be measured for payment. Saw cut will be measured by the linear foot unless otherwise noted.

### 3.4 EXISTING UTILITIES

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

### 3.5 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  - 2. Remove items indicated on drawings.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.

2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  3. Verify that abandoned services serve only abandoned facilities before removal.
  4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- D. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
  4. Patch as specified for patching new work.

### 3.6 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.
- D. Designated salvageable material shall be removed, without unnecessary damage, in sections which may be readily transported. Salvageable material shall be stacked at specified storage areas by the Contractor. When no storage sites are specified, salvaged materials shall be delivered to the street maintenance yard. Materials not designated to be salvaged shall be disposed of, off the project, outside the view of the traveling public with written permission of the property owner on whose property the material is placed.

END OF SECTION 024113

## SECTION 024119 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

##### B. Related Requirements:

1. Section 017300 "Execution" for cutting and patching procedures in new and existing work.
2. Section 070150 "Preparation for Re-Roofing" for roofing tearoff.

#### 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.

#### 1.4 PREINSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
  1. Inspect and discuss condition of construction to be selectively demolished.
  2. Review structural load limitations of existing structure.
  3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  5. Review areas where existing construction is to remain and requires protection.
  6. Review requirements of NFPA 241.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
  - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.
- 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. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Use of elevator and stairs.
  - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

## 1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

## 1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.8 FIELD CONDITIONS

- A. Owner will occupy building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Before building demolition, Owner will remove items so indicated on the Drawings.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- 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 suspected 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 is not 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.

#### 1.9 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- 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 ASSE A10.6 and NFPA 241.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Engineering Survey: Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- C. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- D. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

#### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off utilities with utility companies.
  - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: 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 furniture, furnishings, and equipment that have not been removed.
  - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- 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. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. 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. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. 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.
5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

- 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.

- C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

- D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
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.

- E. 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.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
  - 1. Salvage existing face brick as indicated.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- E. Roofing: Refer to Section 070150 "Preparation for Reroofing."

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

- A. 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.

### 3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Refer to schedule on Drawings.

END OF SECTION



## SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.

## 1.2 PREINSTALLATION MEETINGS

## A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete maintenance including, but not limited to, the following:
  - a. Verify concrete-maintenance specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
  - b. Materials, material application, sequencing, tolerances, and required clearances.
  - c. Concrete repair plan.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

## B. Samples: Cured Samples for each exposed product and for each color and texture specified, in manufacturer's standard size appropriate for each type of work.

## C. Samples for Verification: Cured Samples for each exposed product and for each color and texture specified.

1. Include sets of patching-material Samples in the form of briquettes, at least 3 inches long by 1-1/2 inches wide representative of the range of concrete colors on the building. Document each Sample with product, mix, and or other information necessary to replicate it.

## 1.4 INFORMATIONAL SUBMITTALS

## A. Qualification Data: For installer.

## B. Concrete Repair Plan: Submit before work begins.

## 1.5 QUALITY ASSURANCE

## A. Manufacturer Qualifications: Manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

- B. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.
- C. Concrete Repair Plan: Prepare a written plan for concrete maintenance to characterize various damaged and deteriorated concrete substrates and proposed methods and materials for repair. Plan shall systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail proposed methods and materials to repair each type of damaged or deteriorated concrete substrate.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.
- C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.
  - 1. Use only Class A epoxies when substrate temperatures are below or are expected to go below 40 deg F within eight hours.
  - 2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below 60 deg F within eight hours.
  - 3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above 60 deg F for eight hours.
- B. Cold-Weather Requirements for Cementitious Materials: Do not apply unless concrete-surface and air temperatures are above 40 deg F and will remain so for at least 48 hours after completion of Work.
- C. Cold-Weather Requirements for Cementitious Materials: Comply with the following procedures:
  - 1. When air temperature is below 40 deg F, heat patching-material ingredients and existing concrete to produce temperatures between 40 and 90 deg F.
  - 2. When mean daily air temperature is between 25 and 40 deg F, cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 48 hours after repair.
  - 3. When mean daily air temperature is below 25 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for 48 hours after repair.

- D. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of 90 deg F and above.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: For repair products, obtain repair materials from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties and technical expertise to select appropriate systems for various conditions on the project.
- B. Available manufacturers: Subject to compliance with requirements, available manufacturers that may be able to provide products to be incorporated into the project include the following:
  - 1. Ardex Americas.
  - 2. Dayton Superior.
  - 3. Euclid Chemical Company.
  - 4. Master Builders Solutions (formerly BASF).

### 2.2 CRACK REPAIR

- A. Low viscosity polyurethane Crack and Joint Repair Material: Two-component, trowelable and gun-grade, gravity fed.
  - 1. Basis of Design: Ardex Ardifix.
- B. Applications: Interior and exterior cracks, spalls, and popouts.
- C. Performance Requirements:
  - 1. Tensile Strength: 4150 psi per ASTM D638.
  - 2. Elongation: 243 pli per ASTM D 624.
  - 3. Shore D Hardness: 70.

### 2.3 BONDING AGENTS

- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, Portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.
  - 1. Basis of Design: Ardex BACA Bonding and Anti-Corrosion Agent.
- B. Performance Requirements:
  - 1. Bond Strength, at 2 hours: 1800 psi per ASTM C882.
  - 2. Bond Strength, at 24 hours: 2100 psi per ASTM C882.
  - 3. Flexural Strength at 28 days: 20000 psi per ASTM C78.

- C. Application: At exposed reinforcing steel and elsewhere as indicated or recommended by manufacturer to bond new concrete to existing.

## 2.4 PATCHING MORTAR

### A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary, to achieve suitable matches.

- B. Job-Mixed Patching Mortar: 1-part portland cement and 2-1/2 parts fine aggregate complying with ASTM C144, except 100 percent passing a No. 16 sieve.

### C. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Basis of Design: Ardex CP.
2. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C109/C109M.
3. Application: Interior and exterior reslope or re-form from 1/4 inch to 1/2 inches, neat, and 2 inches with aggregate.
4. Aggregate, where required: Clean, uniformly graded saturated-surface-dry 3/8-inch aggregate.

### D. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.

1. Basis of Design: Ardex FDM.
2. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C109/C109M.
3. Application: Overlays and full depth structural repairs from 1/2 inch to 4 inches, neat, and 8 inches with aggregate.
4. Aggregate, where required: Clean, uniformly graded saturated-surface-dry 3/8-inch aggregate.

- E. Primer: Provide bonding/anti-corrosion agent or primer as recommended by manufacturer for application:

1. Basis of Design: Ardex P71.

- F. Mortar Scrub Coat: Mix consisting of 1-part portland cement and 1 part fine aggregate complying with ASTM C144 except 100 percent passing a No. 16 sieve.

## 2.5 MISCELLANEOUS MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

- B. Water: Potable.

## 2.6 MIXES

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
  - 1. Do not add water, thinners, or additives unless recommended by manufacturer.
  - 2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
  - 3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.
- B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.

## PART 3 - EXECUTION

### 3.1 CONCRETE MAINTENANCE

- A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.
- B. Comply with manufacturers' written instructions for surface preparation and product application.

### 3.2 EXAMINATION

- A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.
- C. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

### 3.3 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
  - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
  - 2. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and

inquiries as necessary to determine condition of construction to be removed in the course of repair.

### 3.4 REMOVAL OF CONCRETE

- A. Do not overload structural elements with debris.
- B. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- C. Remove additional concrete, if necessary, to provide a depth of removal of at least 1/2 inch over entire removal area.
- D. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch clearance around bar.
- E. Test areas where concrete has been removed by tapping with hammer and remove additional concrete until unsound and disbonded concrete is completely removed.
- F. Provide surfaces with a fractured profile of at least 1/8 inch that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- G. Thoroughly clean removal areas of loose concrete, dust, and debris.

### 3.5 FLOOR-JOINT REPAIR

- A. Comply with manufacturer's written recommendations for undercutting sides of cracks and other preparation of concrete at cracks and mixing of joint repair material.
- B. Fill joints in accordance with manufacturer's written recommendations.
- C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

### 3.6 INSTALLATION OF PATCHING MORTAR

- A. Place patching mortar in accordance with manufacturer's written recommendations.
  - 1. Provide forms where necessary to confine patch to required shape.
  - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply bonding agent/anti-corrosion agent or mortar scrub coat as recommended by manufacturer.
- C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

- D. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a surface matching adjacent concrete.

END OF SECTION

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## SECTION 031100 – CONCRETE FORMWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
  - 1. Providing formwork for concrete and shotcrete.
  - 2. Providing construction joint waterstops.
  - 3. Installing cast-in anchors, inserts, sleeves and similar items furnished under other Sections.
- C. Related Sections:
  - 1. Division 03 Section "Concrete Reinforcing".
  - 2. Division 03 Section "Cast-in-place Concrete."

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. ACI – American Concrete Institute:
  - 1. ACI 301                      Specifications for Structural Concrete
  - 2. ACI 347                      Guide to Formwork for Concrete

#### 1.3 SUBMITTALS

- A. Product data for proprietary products, including forming accessories, waterstops and joint systems.
- B. Schedule showing Contractor's proposed location of construction joints not indicated on Drawings.
- C. Samples: Only as requested by Architect's Representative.
- D. Survey anchor bolts location and elevation prior to casting concrete.

#### 1.4 QUALITY ASSURANCE

### PART 2 - PRODUCTS

#### 2.1 FORM MATERIALS

- A. Form Materials: Plywood, steel, fiberglass, reinforced plastic, or any material that will produce concrete with the required finish and within the specified tolerances.
  - 1. Use of aluminum form materials in contact with concrete is prohibited.
- B. Smooth Form Finish: PS1 plywood intended for concrete formwork, edge sealed, no mill oil. Type B-B Plyform, MDO or HDO overlain plywood.
  - 1. Where finish is exposed to view in completed construction, use only overlain plywood.
- C. Foam Filler: ASTM C578; Type IX expanded polystyrene, or Type VII extruded polystyrene foam.

#### 2.2 ACCESSORIES

- A. Form Ties: Snap off metal tie of fixed length with plastic cone, designed to prevent spalling of concrete upon removal. Provide units that will leave no metal within 1-inch (25 mm) of concrete surface.
- B. Form Release Agent: Water-based, colorless, nonstaining, chemically active agent that shall not impair bonding of paint or other coatings intended for use. Formulated for use on form facing material.
  - 1. Lumber, plywood or MDO overlain plywood: Aqua-Nox F by Nox-crete, or approved equal.
  - 2. HDO overlain plywood, steel or fiberglass: Nox-crete PCE by nox-crete, or approved equal.
- C. Expansion Joint Filler: Preformed asphalt impregnated fiber, ASTM D1751, 1/2 inch thick, unless otherwise noted.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION OF FORMS

- A. Design, construct and maintain formwork in accordance with ACI 347.
- B. Provide positive means of adjustment, such as wedges and jacks, or shores and struts. Adjust formwork before and during concrete placement to achieve the specified tolerances.
- C. Tolerances: Finished work shall conform to tolerances of ACI 117.E.
  - 1. Tolerance for offsets at panel edges in as-cast condition shall conform to ACI 117, Class A for Architectural Concrete, Class B for other surfaces exposed to view, and Class C for all other surfaces.
- D. Construct forms mortar-tight and in a manner to permit removal without damaging the concrete.

- E. Verify that sleeves and other openings, offsets, recesses, channel chases, anchors, ties and inserts are in place before concrete is placed.
  - F. Earth Forms: Footing forms may be omitted and foundation concrete may be placed directly into neatly and accurately cut excavations, provided the excavation walls are stable, a minimum of one inch and maximum of three inches outside the concrete edges indicated on the drawings.
    - 1. Where sides are unstable or excavations are not accurately cut to tolerances of ACI 301, construct formwork to the extent required, at no additional cost to Owner.
    - 2. Hand trim sides and bottom of earth forms; remove loose dirt prior to placing concrete.
  - G. Provide temporary openings in formwork at the base of wall and column forms to allow inspection and cleaning before concrete placement.
  - H. Provide blockouts for mechanical and electrical work wherever necessary, even though not shown on the Drawings.
  - I. Provide 3/4-inch (19 mm) chamfers for external corners.
  - J. Plywood Forms at Exposed Surfaces:
    - 1. Keep number of panel joints to practical minimum.
    - 2. Ensure vertical joints are plumb and horizontal joints are level.
    - 3. Align form ties vertically and horizontally.
  - K. Shoring: Shores and struts shall be provided with positive means of adjustment and settlement shall be taken up during construction.
  - L. Form Release Agent: Apply a coating of form release agent immediately before use, but prior to installation of reinforcing steel and embedded items.
  - M. Construction Joints:
    - 1. Provide where shown or noted on the Drawings or as approved by the Architect.
    - 2. Provide key indentations at formed joints.
    - 3. Prevent formation of shoulders and ledges.
  - N. Waterstops: Install in construction joints where shown or noted on Drawings. Install in accordance with manufacturer's written instructions, including location, surface preparation, adhesive primer, and butting or lapping of ends.
    - 1. Provide waterstops at the bottom of all elevator pit walls, all four sides, regardless of whether noted on the drawings.
  - O. Expansion Joints: Provide expansion joints and isolation joints where shown or noted on Drawings. Place joint filler in straight line with edge held back 1/8 inch (3 mm) from concrete surface and secured to formwork or previously placed construction.
    - 1. Hold edge back by width of joint where joints are scheduled to receive sealant.
- 3.2 REMOVAL OF FORMWORK
- A. Do not remove forms until concrete has hardened and attained sufficient strength to permit safe removal and adequate support of inherent and imposed loads. It shall be the Contractor's responsibility to limit construction loads to those which can be carried safely by the developed

strength of the structure at the time of loading and by formwork and shoring in-place at the time of loading.

- B. Remove forms carefully to avoid damaging corners and edges of exposed concrete. Prying against the face of concrete shall not be allowed.
- C. After concrete is placed, forms and shores shall remain in place for not less than the following period of time, subject to requirements for additional curing:
  - 1. Columns: 24 hours, unless otherwise noted.
  - 2. Walls: 2 days, unless otherwise noted. 7 days for Architectural Concrete and other concrete surfaces exposed at building exterior.
  - 3. Beams Sides: 2 days, unless otherwise noted.
  - 4. Beam Soffits: Maintain formwork 7 days; shore until concrete achieves design compressive strength, 7 days minimum.
  - 5. One-Way Slab Soffits: Maintain formwork 7 days; shore until concrete achieves design compressive strength, 7 days minimum.
  - 6. Flat Slabs: Maintain form facing material 7 days; shore until concrete achieves design compressive strength, 21 days minimum.
    - a. Upon removal of form facing material, install reshores as soon as practical, but not longer than 4 hours after stripping.
- D. Where concrete placing continues on upper levels, shoring may be required to be in place longer than minimum time noted for purpose of supporting weight of floor or roof pours above.
- E. Where forms are removed in less than 7 days, curing shall be continued as follows:
  - 1. Immediately following form removal thoroughly wet surface.
  - 2. Continue curing in accordance with provisions of Division 03 Section "Cast-in-Place Concrete".
- F. Reuse of Forms: Forms may be reused provided they are straight, clean, free from nails, dirt, hardened concrete, rust, and other injurious matter and edges and surfaces are in good condition.
  - 1. Clean and repair damage caused by placing, removal, or storage. Reuse of formwork that would reduce quality of exposed-to-view concrete will not be permitted.
  - 2. Forms shall not be reused for Architectural Concrete if there is evidence of surface wear or defect that would impair the quality of the surface.

END OF SECTION 031100

## SECTION 032000 – Concrete Reinforcement and Accessories

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Contract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes: Concrete reinforcement and accessories.

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. ACI – American Concrete Institute:
  - 1. ACI 117 Tolerances for Concrete Construction
  - 2. ACI 301 Specifications for Structural Concrete
  - 3. ACI 315 Standard Practice for Detailing Reinforced Concrete Structures
- C. ASTM International:
  - 1. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - 2. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - 3. ASTM A706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
  - 4. ASTM A970 Standard Specification for Headed Steel Bars for Concrete Reinforcement
- D. CRSI – Manual of Standard Practice.
- E. ICBO - Evaluation Reports.

#### 1.3 SUBMITTALS

- A. Submit under provisions of Division 01 Section "General Requirements."
- B. Shop Drawings: Prepare placing drawings in accordance with ACI 315. Show size, shape and location of bars and wire fabric in structure. Show splice locations and lengths. Where details are not shown, conform to standards of practice indicated in ACI 315 and submit for approval.
  - 1. Bill reinforcing bars for walls on elevations. Bill reinforcing bars for slabs on plans. Plans and elevations need not be true views. When more than one wall or slab are

- identical, only one such wall or slab is required. Take sections to clarify the arrangement of reinforcement. Identify, but do not bill bars on sections.
2. Unless the location of reinforcing is clear, give dimensions to some structural feature that will be readily distinguishable at time bars are placed.
  3. Make placing drawings complete, including the location of support bars and chairs, without reference to the design drawings.
- C. Submit data required to evaluate proposed mechanical splices.
  - D. Submit manufacturer's certified mill test reports on each heat of reinforcing steel delivered, showing physical and chemical analysis before placing reinforcement.

#### 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of ACI 301 CRSI's "Manual of Standard Practice", except where more stringent requirements are shown or specified.
- B. Requirements of Regulatory Agencies: Proprietary products, including bar couplers, shall have an active ICBO Evaluation Report.
- C. Material Quality Assurance: Mill test reports including chemical analysis, tensile properties and bend test shall be examined for all reinforcing.
- D. Maintain positive identification of reinforcing by heat number. Provide certified mill test reports to Testing Laboratory.
- E. Where positive identification cannot be made and procedures are not deemed adequate to ensure compliance, Testing Laboratory will randomly sample and make one tensile and one bend test from each 2-1/2 tons or fraction thereof of each size of reinforcement. Contractor will bear the cost of testing.

### PART 2 - PRODUCTS

#### 2.1 REINFORCING MATERIALS

- A. Bar Reinforcement: ASTM A615, Grade 60, deformed carbon bars.
  1. ASTM A706, only where noted on Drawings.
- B. Headed Bar Reinforcement: ASTM A970.
- C. Spirals: ASTM A1064.
- D. Welded Wire Fabric: ASTM A1064.
- E. Smooth Dowels, ASTM A615, Grade 60, smooth; sawcut or grind one end to remove offsets; shop paint with iron oxide zinc chromate primer.
- F. Mechanical Bar Couplers: Provide mechanical couplers with a current ICC evaluation report. Coupler shall develop 160% percent of specified minimum yield strength of spliced reinforcement.

## 2.2 ACCESSORIES

- A. Tie Wire: Minimum 16-gage black annealed wire.
- B. Bar Supports:
  - 1. At surfaces not exposed to view in completed structure: Precast concrete bar supports with two 16 ga. embedded wires or CRSI Class 2 wire supports.
  - 2. Supports placed against ground or on top of vapor barrier: Precast concrete blocks not less than 3 inches square (1935 mm<sup>2</sup>) with two 16 ga embedded wires.
  - 3. At Architectural Concrete and surfaces exposed to weather: CRSI Class 2 stainless steel or CRSI Class 1 plastic protected.
  - 4. Where support is no closer to concrete surface than 1/2 inch (13 mm): CRSI Class 3 wire supports.

## 2.3 FABRICATION

- A. Fabricate reinforcement in accordance with ACI 315 where specific details are not shown.

## PART 3 - EXECUTION

### 3.1 PLACEMENT

- A. Surface Condition of Reinforcement: Before placing concrete, clean reinforcement of loose scale, dirt, grease and other substances which would impair bond with concrete.
- B. Place reinforcement in accordance with the Drawings and the CRSI Manual.
  - 1. Steel bars shall be of size and length indicated, accurately bent or formed to shapes detailed or scheduled by experienced shops by methods that will not injure the materials. Reinforcing bars shall be shop fabricated to lengths and bends shown on the drawings. Fabrication tolerance shall be in accordance with the requirements of ACI 315.
  - 2. Reinforcing bars shall be as long as possible with a minimum number of joints.
  - 3. Steel reinforcement shall not be bent or straightened in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the Drawings shall not be used. Heating of reinforcement for bending will not be permitted.
  - 4. Reinforcement shall be tagged with suitable identification to facilitate sorting and placing.
- C. Place reinforcing bars accurately as to spacing and clearance and securely tied at intersections and supports with wire and in such a manner as will preclude displacement during pouring of concrete. Placing tolerances shall be in conformance with the requirements of ACI 117.
- D. Place and secure reinforcement to maintain the proper distance and clearance between parallel bars and from the forms. Provide vertical steel with metal spreaders to maintain steel properly centered in the forms. Horizontal reinforcement shall be supported at proper height on concrete pads, chairs or transverse steel bars.
- E. After placing, maintain bars in a clean condition until completely embedded in concrete.
- F. Bars shall not be spaced closer than 1-1/2 diameters of the largest of two adjacent bars, 1-1/2 times the maximum aggregate size, nor one inch, except at bar laps. Where reinforcement

in members is placed in two layers, the clear distance between layers shall be not less than one inch (25 mm) or more than 1-1/2 inches (38 mm) unless otherwise noted on the drawings. The bars in the upper layer shall be placed directly above those in the bottom layer unless otherwise detailed.

- G. Coverage of bars shall be as shown and scheduled. Conform to ACI 301 where not indicated.
- H. Where obstruction prevents the intended placement of reinforcement, provide additional reinforcement as directed by the Architect around the obstruction.
- I. Splice bars as indicated by lapping and securely wiring together. Splices at locations other than those indicated are subject to the approval of the Architect. Splices of reinforcement shall not be made at the point of maximum stress. Splices shall provide sufficient lap to transfer the stress between bars by bond and shear. Bars shall be spread the minimum distance specified. Stagger splices of adjacent bars where possible.
- J. Reinforcing bars shall not have welded joints.
- K. Mechanical Bar Couplers: Install in accordance with applicable ICC evaluation report. Maintain clearance and coverage at coupler. Stagger couplers wherever practical.

### 3.2 FIELD INSPECTION

- A. Architect will:
  - 1. Review Quality Assurance procedures for maintaining identification of steel. Collect certificates of compliance and test reports for reinforcing steel.
  - 2. Periodic visually inspection of placement of reinforcement for conformance with the Contract Documents and as required by IBC Chapter 17.

END OF SECTION 032000



## SECTION 033000 - Cast-In-Place Concrete

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes
  - 1. Concrete reinforcement.
  - 2. Cast-in-place concrete.
- C. Related Sections:
  - 1. Section 031000 - Formwork
  - 2. Section 032000 - Concrete Reinforcement

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. American Concrete Institute (ACI):
  - 1. ACI 211.1 Proportions for Normal, Heavyweight and Mass Concrete
  - 2. ACI 301 Specifications for Structural Concrete
  - 3. ACI 303R Guide to Cast-In-Place Architectural Concrete Practice
  - 4. ACI 305.1 Specification for Hot Weather Concreting
  - 5. ACI 306.1 Standard Specification for Cold Weather Concreting
  - 6. ACI 308.1 Specification for Curing Concrete
  - 7. ACI 309 Consolidation of Concrete
  - 8. ACI 318 Building Code Requirements for Structural Concrete
- C. ASTM International:
  - 1. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  - 2. ASTM A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - 3. ASTM C31 Making and Curing Concrete Test Specimens in the Field
  - 4. ASTM C33 Concrete Aggregates
  - 5. ASTM C94 Ready Mix Concrete
  - 6. ASTM C143 Test Method for Slump of Portland Cement Concrete
  - 7. ASTM C150 Portland Cement
  - 8. ASTM C156 Test Method for Water Retention by Concrete Curing Materials
  - 9. ASTM C1602 Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

10. ASTM C171 Sheet Materials for Curing Concrete
11. ASTM C172 Sampling of Freshly Mixed Concrete
12. ASTM C260 Air Entraining Admixtures for Concrete
13. ASTM C309 Liquid Membrane - Forming Compounds for Curing Concrete
14. ASTM C138 Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
15. ASTM C330 Lightweight Aggregates for Structural Concrete
16. ASTM C494 Chemical Admixtures for Concrete
17. ASTM C567 Test Method for Unit Weight of Structural Lightweight Concrete
18. ASTM C618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
19. ASTM C881 Epoxy - Resin - Base Bonding Systems for Concrete
20. ASTM E1745 Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

- D. American Association of State Highway and Transportation Officials (AASHTO):
1. M182-60 - Burlap Cloth Made for Jute or Kelat.

- E. American Institute of Steel Construction (AISC) Code of Standard Practice

### 1.3 SUBMITTALS

- A. Mix design for each concrete mix sealed by a professional engineer or record of verification by trial mixtures or historical data in accordance with ACI 318 and Section 1.05 Quality Assurance
1. Include compression test data used to establish mix proportions.
- B. Submit certification that all facilities of the ready-mix plant comply with the requirements of ASTM C94.
- C. Material Certificates.
1. Cementitious materials, including fly ash.
  2. Aggregates, including gradation and combined gradation.
  3. Admixtures. Where more than one admixture is proposed, include statement from admixture manufacturer indicating that admixtures proposed for use are compatible, such that desirable effects of each admixture will be realized.
- D. Product Data: Provide data form proprietary materials, including admixtures curing materials, and finish materials.
- E. Submit ticket to Testing Laboratory for each batch of concrete delivered, bearing the following information. Refer to "Field Quality Control" Article of this Section.
- F. Mix identification.
- G. Weights of cementitious materials, aggregates, water and admixtures, and aggregate size.
- H. Samples: As requested by Testing Laboratory.
- I. Submit placement drawings, showing location of construction joints, if the location of construction joints will be different than shown on the construction drawings.

- J. Submit test reports from the independent testing agency for review by the Architect.

#### 1.4 QUALITY ASSURANCE

- A. Standards: Comply with provisions of ACI 301, except where more stringent requirements are shown or specified. Evaluation and acceptance of concrete structures will be in accordance with ACI 301.
- B. Concrete Mix Design: Testing laboratory shall, under direction of its registered Civil Engineer, design concrete mixes. Each mix shall bear the signature, seal and registration expiration date of the engineer directing the design work. For mixes containing greater than twenty five percent fly ash, the Testing laboratory shall produce calculations and test batches in accordance with the recommendations of ACI 211.1 to determine the minimum water content and to confirm workability, curing time and compressive strength.
- C. Certificates of Compliance: Acceptability of the following materials will be based upon documentation furnished by the manufacturer identifying each batch of material and certifying compliance with the requirements specified:
  - 1. Portland cement.
  - 2. Fly ash.
  - 3. Chemical admixtures.
- D. Certified laboratory test reports: Before delivery of materials, certified copies of the reports of all tests required in referenced publications or otherwise specified here shall be submitted. The testing shall have been performed by an independent laboratory approved by the Architect within one year of submittal of test reports for approval. Test reports on a previously tested material shall be accompanied by notarized certificates from the manufacturer certifying that the previously tested material is of the same type, quality, manufacture and make as that proposed for use in this project. Certified test reports are required for the following:
  - 1. Portland Cement.
  - 2. Aggregates.
  - 3. Admixtures.
- E. Survey anchor bolts for placement and alignment prior to casting concrete.

### PART 2 - PRODUCTS

#### 2.1 FORM MATERIALS

- A. See Section 031000 – Concrete Formwork

#### 2.2 REINFORCING STEEL

- A. Reinforcing Steel: ASTM A615 (unless otherwise noted on the drawings), of the yield grade specified on the drawings; deformed plain carbon steel bars.
  - 1. Recycled content shall be a minimum of 75% recycled post-consumer steel.
- B. Welded Wire Reinforcement: ASTM A1064.
- C. See Section 032000 – Concrete Reinforcement

## 2.3 CONCRETE MATERIALS

- A. Cement: Type 1 ASTM C150, normal-weight unless noted otherwise.
  - 1. Cement for lightweight concrete shall conform to ASTM C330.
- B. Cementitious materials and aggregates for exposed concrete shall be from same source throughout the work.
- C. Cementitious Material: An intimate blend of Portland cement and fly ash.
  - 1. Portland Cement: ASTM C150, Type II, low alkali.
  - 2. Fly Ash: ASTM C618, Class F with the following Modified ASTM requirements:
    - a. Loss of Ignition (L.O.I.): maximum 1%.
    - b. Sulfur Trioxide (SO<sub>3</sub>) shall not exceed 3% by weight.
    - c. Water requirement maximum: 100% control.
    - d.  $R = (\text{CaO} - 5\%) / (\text{Fe}_2\text{O}_3)$ , where R (sulfate resistance) is 0.75 maximum and CaO/Fe<sub>2</sub>O<sub>3</sub> is the percentage from fly ash oxide analysis.
- D. Aggregate for Standard Weight Concrete: ASTM C33.
  - 1. Maximum size aggregate shall be 1-1/2" long for footings and 3/4" for wall and slabs.
- E. Aggregate for Lightweight Concrete: ASTM C330. Lightweight aggregate shall be vacuum saturated expanded shale or clay produced by rotary kiln.
- F. Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete: ASTM C1602.
- G. Admixtures:
  - 1. General:
    - a. Where mix contains more than one admixture, all admixtures shall be supplied by one manufacturer. Manufacturer shall certify that admixtures are compatible such that desirable effects of each admixture will be realized.
    - b. Liquid admixtures shall be considered part of the total water.
- H. Waterproofing Admixture:
  - 1. The waterproofing admixture shall be used at elevator pit slab and walls.
  - 2. The concrete waterproofing admixture shall be of the cementitious crystalline type that chemically controls and permanently fixes a non-soluble crystalline structure throughout the capillary voids of the concrete.
  - 3. The design shall include the use of the crystalline waterproofing repair materials that generate a non-soluble crystalline formation in the concrete.
  - 4. The concrete crystalline waterproofing admixture shall be specifically formulated as a concrete admixture.
  - 5. Xypex Admix C-1000.
  - 6. The dosage rate for the Xypex Admix C-1000 shall be 3% by weight of cement.
  - 7. Crack Bridging Capability: Requirement: Crystalline Waterproofing shall be capable of sealing static cracks up to 1/64".
  - 8.
- I. Lightweight Concrete shall contain an air entrainment admixture conforming to ASTM C260, to produce an air content of 3 to 5 percent at point of placement.
- J. Water Reducing Admixture: ASTM C494, Type A. Provide in all concrete at necessary dosage to facilitate placement.

- K. Mid to High Range Water Reducing Admixture: ASTM C494, Type F; polycarboxylate formulation. Provide in mid-range or high-range dosage as necessary for placement at the maximum water to cement ratio specified.
- L. Set Accelerating Admixture: ASTM C494, Type E, non-chloride. Subject to approval of Architect's Representative, provide in necessary dosage to accelerate set.
- M. Set Retarding Admixture: ASTM C494, Type D. Subject to approval of Architect's Representative, provide in necessary dosage to retard set.
- N. Color Admixtures: ASTM C579.

#### 2.4 ACCESSORIES

- A. Curing Compounds: ASTM C309, which will not discolor concrete or affect bonding of other finishes applied thereover, and which restricts loss of water to not more than 0.500 grams per square centimeter of surface when tested per ASTM C156, "Test Method for Water Retention by Concrete Curing Materials."
  - 1. Type 1 Clear, Liquid membrane-forming compound, Class A Unrestricted
- B. Slab Curing Membrane: Membrane conforming to ASTM C171, non-staining.
- C. Burlap Sheet: AASHTO M182, class 3 or 4.
- D. Surface Hardener: Lapidolith, Hornolith, Kemi-Kal Liquid or equal.
- E. Rock Base: Clean, hard and durable gravel or crushed rock.
- F. Vapor Barrier: Polyethylene sheet not less than 10 mils thick that is resistant to deterioration when tested according to ASTM E 154
  - 1. Lap 12" to accommodate pouring direction
- G. Sand Cover: See Section 312323 Select Fill and Backfill
  - 1. Note native, uncompacted soil is acceptable backfill for pile-supported slabs.
  - 2. "Dry bottom" slabs for pile cap or grade beam formation shall be Select Fill. Inclusion of dry bottoms are at the discretion of the Contractor.
- H. Geofoam or Closed Cell Extruded Polystyrene (EPS): ASTM D6817, nominal density = 15psi, basis of design = EPS15 w termiticide.
- I. Expansion Joint Filler: non-extruded premolded material composed of fiberboard impregnated with asphalt conforming to the requirements of ASTM D1751
- J. Waterstops: Waterstop-RX Volclay waterproofing by American Colloid Company or approved equal unless noted otherwise.

#### 2.5 CONCRETE MIXES

- A. Aggregate: Coarse aggregate size number in accordance with ASTM C33 for normal-weight aggregate. Coarse aggregate size in accordance with ASTM C330 for lightweight aggregates. Maximum size aggregate = 3/4 inch.

- B. Slump: 5" maximum slump at point of placement in inches when tested in accordance with ASTM C143.
- C. Strength: Minimum compressive strength in psi per Design Drawings, tested in accordance with ASTM C39.
- D. Air Content: Max 6%
- E. Maximum water soluble chloride ion. (Cl<sup>-</sup>) = 0.30% for Class CI by percentage of cement material by weight.
- F. Pozzolan maximum content by percentage of cementitious material by weight.
  - 1. Fly Ash: Maximum 25%
  - 2. Calcined Pozzolan Content: Maximum 10%
  - 3. Silica Fume: Maximum 5%
- G. Water to Cementitious Material Ratio: Water-to-cementitious-material ratio not exceeding 0.45 by weight. Weight of water shall include all free moisture, including liquid admixtures. Mixes shall contain specified high range water reducing admixture at mid-range dosage as required to achieve specified slump.
- H. Lightweight Concrete: Equilibrium weight (at 100 days air dry) of 113 pcf plus or minus 3 pcf, ASTM C567. Mix shall contain 4 percent, plus or minus 1 percent, entrained air by volume at point of placement.
- I. Proposed mixes shall produce concrete to strengths specified with adequate workability and proper consistency to permit concrete to be worked into forms and around reinforcement without excessive segregation or bleeding.
- J. Mix design shall be subject to review by the Architect's Representative and the Testing Laboratory. Mixes shall be submitted in ample time for review and adjustment, if necessary.
- K. Add air entraining agent to normal weight concrete mix for work exposed to exterior.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify site conditions under provisions of Division 01 Section "General Requirements".
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchor bolts, embedded plates, reinforcement, sleeves and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

#### 3.2 FORMWORK ERECTION

- A. Verify lines, levels, and measurement before proceeding with formwork.
- B. Hand trim sides and bottom of earth forms; remove loose dirt.

- C. Align form joints.
- D. Do not apply form release agent to concrete surfaces which receive special finishes that may be affected by agent.
- E. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

### 3.3 REINFORCEMENT & EMBEDDED ITEMS

- A. Place, support, and secure reinforcement and embedded items against displacement.
- B. Installation tolerances for anchor bolts for structural steel columns shall comply with the AISC Code of Standard Practice tolerances.
- C. Only items that are dimensionally located on the drawings may be embedded in concrete regardless of the trade responsible for placing them.
- D. Provide lap splices, standard hooks, and corner bars as indicated on the Drawings
- E. Provide suitable wire spacers, chairs, ties, brickettes etc. for supporting reinforcing steel in the proper position while placing concrete. Do not "wet stick" dowels.
- F. Locations and sizes of openings, sleeves, etc. required for other trades must be verified by these trades before placing concrete.
- G. All slots, sleeves, trenches, and other embedded items shall be set and secured against movement before the concrete is placed. See Architectural, Electrical, Mechanical, Plumbing, and Vendor drawings for sizes and locations.
- H. Conduits and pipes embedded in concrete slabs may be no larger than 1/3 of the slab thickness (based on the maximum outside diameter) and shall have a center-to-center spacing no less than three (3) conduit diameters. Regardless of diameter, the minimum clear spacing between conduits or reinforcing shall be one (1) inch.
- I. No aluminum conduits, devices, or fixtures may be embedded into the concrete so that the aluminum is in direct contact with the concrete.
- J. No conduits shall be placed in slabs within 12 inches of column face or face of bearing wall.
- K. Provide waterstops at the bottom of all elevator pit walls, all four sides, regardless of whether noted on the drawings.

### 3.4 PLACING CONCRETE

- A. Notify the Architect at least 48 hours prior to commencement of concreting operations. No concrete shall be placed until all subgrade, formwork, reinforcing steel, embedded items and surfaces against which concrete is to be placed have been accepted by the Architect. The rate of delivery, haul time, missing time and hopper capacity shall be such that all mixed concrete delivered shall be placed in forms within 90 minutes from the time of the introduction of cement and water into the mixer. No water shall be added after transit mixer leaves the batching plant without the approval of the Architect.

- B. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instruction.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with epoxy grout.
- D. Foundation surfaces against which concrete is to be placed must be free from standing water, mud and debris. Surfaces shall be clean and free from oil, objectionable coatings, and loose or unsound material.
- E. All surfaces of forms and embedded items shall be free of grout before placing concrete.
- F. Location of construction joints shall be as shown on the structural drawings.
- G. When ambient temperature is expected to exceed 80°F during placing or finishing operations, steps shall be taken in accordance with ACI 305, "Recommended Practices for Hot Weather Concreting", to reduce concrete temperature and water evaporation by proper attention to the ingredients, production methods, handling, placing, protection and curing. The Contractor shall submit a detailed hot weather concreting procedure to the A/E for approval at least two business days before concrete placement is planned. The Contractor's testing agency will produce trial batches in accordance with ACI 305. Slabs will be fog sprayed from the completion of screeding until curing is begun; the fog spray may be discontinued on sections during troweling.
- H. When ambient temperature is expected to be below 40° F during placing or finishing operations, steps shall be taken in accordance with ACI 306, "Recommended Practices for Cold Weather Concreting".

### 3.5 FLOOR SLABS

- A. Place floor slabs as indicated on Drawings. Saw cut control joints at an optimum time after finishing. Cut slabs with a 3/16-inch thick blade to 1 inch depth.
- B. Separate slabs on grade from vertical surfaces with joint filler. Extend joint filler from bottom of slab to within ¼ inch of finished slab surface.
- C. Finish surfaces as scheduled.
- D. Install joint devices and joint device anchors in accordance with manufacturer's instructions. Maintain correct position to allow joint cover flush with floor finish.
- E. Construct slab on grade and shored elevated floor slabs with overall specified FF25/FL20 and with minimum FF20/FL15 for individual floor sections in accordance with ACI 302.1. Determination of FF/FL numbers will be in accordance with ASTM E 1155. The Contractor will take remedial measures when floor slabs do not meet specified requirements. The Contractor's plan for remedial measures shall be submitted to the Architect for review and approval.
- F. Where control joints are required, saw cuts shall be made as soon as the concrete can support the saw without damaging the surface. Maximum (8) hours after the start of concrete pour.



### 3.6 CURING AND PROTECTION

- A. Wheeling, working and walking on concrete shall be avoided for at least 24 hours after casting. Protect concrete from sun and rain. Do not permit concrete to become dry during curing period. Concrete shall not be subjected to any loads until concrete is completely cured, and until concrete has attained its 28-day strength.
- B. Protect concrete during and after curing from damage during subsequent building construction operations.
- C. Cover traffic areas with plywood or other suitable means for as long as necessary to protect concrete from damage.
- D. Concrete may be cured with the application of a curing blanket as described below or the use of a curing compound following the requirements of Section 2.04 or another alternative curing plan requested by the Contractor. It is the responsibility of the Contractor to adequately cure the concrete and the curing mechanism is their discretion. EOR is not responsible for non-structural shrinkage cracking that may occur with inadequate curing practices or with the substitution of a curing compound in lieu of curing blankets.
- E. Specific curing requirements for slabs shall include the following unless Contractor elects to submit an alternative plan: Immediately upon completion of finishing operation, the surface of slabs shall be sealed against moisture loss by the application of a curing blanket made of polyethylene bonded to burlap in accordance with the manufacturer's instructions. Alternatively, waterproof curing paper may be used with edges lapped and sealed with tape. The curing membrane shall be weighted down. Tears and rips in curing membrane shall be repaired immediately during curing period. Curing shall be maintained for 7 days.
- F. Specific curing requirements for walls, beams and columns shall include the following unless Contractor elects to submit an alternative plan: Concrete in forms shall be kept moist until removal. Immediately upon removal of forms, an approved sprayed-on curing compound shall be applied to the concrete surfaces in strict compliance with the manufacturer's recommendations. Curing shall be maintained for 7 days.
- G. For above grade concrete sections over three feet thick except lean concrete (if required):
  - 1. Ten days before placing concrete, the results of a thermal test performed by the Contractor will be submitted to the Architect for approval. Thermal tests shall consist of a three-foot test cube of the design mix for the thick section instrumented with thermocouples by the Contractor's testing agency and monitored to determine whether the heat of hydration exceeds 150°F. If the temperature exceeds 150°F, the mix design will be revised or standard aggregate cooling utilized and a second test cube cast and tested at no additional cost to the Architect.
  - 2. The temperature gradient between the center and the surface of the section must not exceed 20°F during the first ten days of the controlled curing period. Thermocouples shall be installed by the Contractor's testing agency in the center and six inches from the surface at twenty-foot intervals and at the corners. The thermocouples are to be monitored continuously by the Contractor's testing agency and, if the temperature gradient exceeds 20°F, insulating blankets shall be placed over the surface. On surfaces with protruding reinforcing, such as the top of a wall, loose insulation will be used.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner or Contractor will engage a qualified testing agency to perform material tests and inspections.
- B. If the Engineer is not engaged or notified by the Contractor to provide Code-required periodic inspection, the Contractor shall bear the expense and responsibility of engaging a qualified third party inspector, relieving the EOR of periodic inspection duties.
- C. Tests: Perform according to ACI 301.
  - 1. Definition of (1) set: minimum (3) cylinders for testing at (7) days, (3) cylinders for testing at (28) days, and additional (3) cylinders for reserve. Sample in accordance with ASTM C172.
  - 2. Testing Frequency: Obtain at least (1) set of cylinders for each 100 cubic yd. or fraction thereof of each concrete mixture placed each day. Minimum (1) set of cylinders per day of concrete placement.
  - 3. Samples shall be properly cured and stored. Prepare cylinders in accordance with ASTM C31.
  - 4. Test concrete cylinders in accordance with ASTM C39 by a qualified Testing Agency and submit results to Architect for review within (3) days.
  - 5. Testing Agency will provide slump tests per ASTM C143 air content testing per ASTM C231 or C173, temperature by ASTM C1064, density by ASTM C138 in the field for each set of cylinders or minimum (1) test each per day of concrete placement. Results shall be submitted to the Architect for review within (3) days.
- D. Visual inspection by the EOR does not guarantee the Contractor's work or alleviate the Contractor from final responsibility to place reinforcement and concrete in accordance with the Contract Drawings and Specifications.
- E. If the Engineer is not engaged or notified by the Contractor to provide Code-required periodic inspection, the Contractor shall bear the expense and responsibility of engaging a qualified third party inspector, relieving the EOR of any periodic inspection duties.

END OF SECTION 033000

## SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Self-leveling, gypsum cement underlayment for application below interior floor coverings.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum cement underlayment.
2. Reinforcement.
3. Primer.
4. Surface sealer.
5. Sound control mat.

- B. **Sustainable Design Submittals:** Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

B. Test Reports:

1. For fire-resistant ratings, from a qualified testing agency.
2. For STC-rated assemblies, from a qualified testing agency.
3. For IIC-rated assemblies, from a qualified testing agency.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

- B. **HUD Manufacturer Qualification:** Gypsum cement underlayment manufacturer shall have a HUD Materials Release.

#### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place gypsum cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
  - 1. STC Rating: [60] [55] [50] [**As indicated on Drawings**].
- C. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E492 and classified according to ASTM E989 by an independent testing agency.
  - 1. IIC Rating: [60] [55] [50] [**As indicated on Drawings**].

## 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  - 1. Low-Emitting Materials: Field applied interior paints and coatings.
  - 2. Responsible Sourcing: Regionally sourced.
  - 3. Responsible Sourcing: Recycled content.
  - 4. Responsible Sourcing: Chemicals of concern.

## 2.3 GYPSUM CEMENT UNDERLAYMENTS

- A. Gypsum Cement Underlayment: Self-leveling, gypsum cement product.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ARDEX Americas.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. Hacker Industries, Inc.
    - d. Maxxon Corporation.
  - 2. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C219.
  - 3. Compressive Strength: Not less than 2000 psi at 28 days when tested according to ASTM C472.
  - 4. Compressive Strength at areas scheduled to receive resilient flooring: Not less than 3000 psi at 28 days when tested according to ASTM C472.
  - 5. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
  - 1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.
- E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- F. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

## 2.4 ACCESSORIES

- A. **Sound Control Mat:** As required to meet STC and IIC ratings, manufactured by gypsum cement underlayment manufacturer.
  - 1. Thickness: As required to meet performance requirements, but not less than 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.
  - 1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  - 2. Fill substrate voids to prevent underlayment from leaking.
- B. **Concrete Substrates:** Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by gypsum cement underlayment manufacturer.

- C. **Wood Substrates:** Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.
  - 1. Install underlayment reinforcement recommended in writing by manufacturer.
- D. **Nonporous Substrates:** For metal, ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond; prepare surfaces according to manufacturer's written instructions.
- E. **Adhesion Tests:** After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.
- F. **Sound Control Mat:** Install sound control materials according to manufacturer's written instructions.
  - 1. Do not install mechanical fasteners that penetrate through the sound control materials.

### 3.3 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.
  - 1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
  - 2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
  - 3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
  - 1. Install a final layer without aggregate to product surface.
  - 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Apply surface sealer at rate recommended by manufacturer.
- G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

### 3.4 INSTALLATION TOLERANCES

- A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unleveled, freestanding, 10-foot-long straightedge resting on two high spots and placed anywhere on the surface does not exceed [**1/4 inch**] [**3/16 inch**] [**1/8 inch**].

3.5 FIELD QUALITY CONTROL

- A. Contractor retain testing agency to confirm compressive strength and perform cube test in accordance with ASTM C109 Standard Test Method for Compressive Strength of Hydraulic Mortars, using 2 inch/50mm cube specimens.
  - 1. Confirm first installation each day and one additional test every 2,000 square feet.

3.6 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

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## SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hydraulic cement underlayment.

- B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

B. Test Reports:

1. For fire-resistant ratings, from a qualified testing agency.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

#### 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## 2.2 HYDRAULIC CEMENT UNDERLAYMENTS

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
  1. Basis of Design: Subject to compliance with requirements, provide Ardex 15 or comparable products by one of the following:
    - a. Ardex America.
    - b. Mapei.
    - c. Laticrete.CTS Cement Manufacturing Corp; Rapid Set.
    - d. Master Builders Solutions.
    - e. Sika.
  2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
  3. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.
  4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.
  1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate acceptable to manufacturer and installer..
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.
- C. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.
- D. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Mix and install underlayment components according to manufacturer's written instructions.
1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
  2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
  3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Install underlayment to produce uniform, level surface.
1. Install a final layer without aggregate to product surface.
  2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Apply surface sealer at rate recommended by manufacturer.

- G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

#### 3.4 INSTALLATION TOLERANCES

- A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unlevelled, freestanding, 10-foot-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch and 1/16 inch in 2 feet.

#### 3.5 PROTECTION

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION

## SECTION 040110 - MASONRY CLEANING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes cleaning the following:
  - 1. Face brick surfaces.
  - 2. Concrete unit masonry surfaces.

#### 1.2 DEFINITIONS

- A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- B. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
    - a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
    - b. Materials, material application, and sequencing.
    - c. Cleaning program.
  - 2. Review mockups.

#### 1.4 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform masonry-cleaning work in the following sequence:
  - 1. Remove plant growth.
  - 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
  - 3. Remove incidental paint on masonry surfaces.
  - 4. Clean masonry surfaces.
  - 5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include material descriptions and application instructions.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For paint-remover manufacturer and chemical-cleaner manufacturer.
- B. Cleaning program.

## 1.7 QUALITY ASSURANCE

- A. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.
- B. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.
  - 1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.
- C. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
  - 1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition. Architect will designate a representative area.
    - a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
    - b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on masonry surfaces.
  - 1. Use test areas as indicated and representative of proposed materials and existing construction.
  - 2. Propose changes to materials and methods to suit Project.

## 1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.

- B. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least seven days after completion of cleaning.

## PART 2 - PRODUCTS

### 2.1 CLEANING MATERIALS

- A. Water: Potable.
- B. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.
- C. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.
- D. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. American Building Restoration Products, Inc.; Building Wash 3.
    - b. Dumond Chemicals, Inc; Safe n' Easy Architectural Cleaner/Restorer.
    - c. PROSOCO, Inc; Enviro Klean 2010; AllSurface Cleaner; Enviro Klean ReVive.

### 2.2 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
  - 3. Neutralize alkaline and acid wastes before disposal.

4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
    1. Provide temporary rain drainage during work to direct water away from building.

### 3.2 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.
- B. Proceed with cleaning in an orderly manner; work from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
  1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
  2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
    - a. Equip units with pressure gages.
    - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.
- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.
- F. Water Application Methods:
  1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
  2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.



- G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
  - 1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- I. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

### 3.3 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
  - 1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
  - 2. Remove paint and calking with alkaline paint remover.
    - a. Comply with requirements in "Paint Removal" Article.
    - b. Repeat application up to two times if needed.
  - 3. Remove asphalt and tar with solvent-type paste paint remover.
    - a. Comply with requirements in "Paint Removal" Article.
    - b. Apply paint remover only to asphalt and tar by brush without prewetting.
    - c. Allow paint remover to remain on surface for 10 to 30 minutes.
    - d. Repeat application if needed.

### 3.4 CLEANING MASONRY

- A. Cold-Water Soak:
  - 1. Apply cold water by intermittent spraying to keep surface moist.
  - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
  - 3. Apply water in cycles of five minutes on and 20 minutes off.
  - 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests.
  - 5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.

- B. Cold-Water Wash: Use cold water applied by low or medium-pressure spray.
- C. Detergent Cleaning:
  - 1. Wet surface with cold water applied by low-pressure spray.
  - 2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet.
  - 3. Rinse with cold water applied by low or medium-pressure spray to remove detergent solution and soil.
  - 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- D. Mold, Mildew, and Algae Removal:
  - 1. Wet surface with cold water applied by low-pressure spray.
  - 2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
  - 3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
  - 4. Rinse with cold water applied by low or medium-pressure spray to remove mold, mildew, and algae remover and soil.
  - 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
- E. Nonacidic Liquid Chemical Cleaning:
  - 1. Wet surface with cold water applied by low-pressure spray.
  - 2. Apply cleaner to surface in two applications by brush or low-pressure spray.
  - 3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
  - 4. Rinse with cold water applied by low or medium-pressure spray to remove chemicals and soil.
  - 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Architect. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observing progress and quality of the work.

### 3.6 FINAL CLEANING

- A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.

- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION

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## SECTION 040123 - MASONRY REPAIR

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes repairing and concrete masonry.

## 1.2 DEFINITIONS

- A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and locations of replacement bricks on the structure.
  - 2. Show provisions for expansion joints or other sealant joints.
- C. Samples: For each exposed product and for each color and texture specified.

## 1.5 QUALITY ASSURANCE

- A. Masonry Repair Specialist Qualifications: Engage an experienced masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.
- B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.
- C. Mockups: Prepare mockups of masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.
  - 1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work.

## PART 2 - PRODUCTS

## 2.1 MASONRY MATERIALS

- A. Face Brick: As required to complete masonry repair work.
  - 1. Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.
    - a. For existing brickwork that exhibits a range of colors or color variation within units, provide that proportionally matches that range and variation rather than that matches an individual color within that range.
  - 2. Special Shapes:
    - a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
    - b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
    - c. Mechanical chopping or breaking brick, or bonding pieces of together by adhesive, are unacceptable procedures for fabricating special shapes.

## 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
  - 1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Masonry Cement: ASTM C91/C91M.
- D. Mortar Cement: ASTM C1329/C1329M.
- E. Mortar Sand: ASTM C144.
  - 1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
  - 2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
- F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
- G. Water: Potable.

## 2.3 MANUFACTURED REPAIR MATERIALS

- A. Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching masonry.
  - 1. Use formulation that is vapor and water permeable (equal to or more than the brick), exhibits low shrinkage, has lower modulus of elasticity than bricks being repaired, and develops high bond strength to all types of masonry.
  - 2. Formulate patching compound in colors and textures to match each being patched.

## 2.4 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of bricks, less the required depth of pointing materials unless removed before pointing.
- B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
  - 1. Previous effectiveness in performing the work involved.
  - 2. Minimal possibility of damaging exposed surfaces.
  - 3. Consistency of each application.
  - 4. Uniformity of the resulting overall appearance.
  - 5. Do not use products or tools that could leave residue on surfaces.

## 2.5 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
  - 1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.
- C. Do not use admixtures in mortar unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 PROTECTION

- A. Remove gutters and downspouts adjacent to masonry and store during masonry repair. Reinstall when repairs are complete.
  - 1. Provide temporary rain drainage during work to direct water away from building.

### 3.2 REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
  - 1. Remove mortar, loose particles, and soil from by cleaning with hand chisels, brushes, and water.
  - 2. Remove sealants by cutting close to with utility knife and cleaning with solvents.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for replacement.
- G. Replace removed damaged with other removed in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.
- H. Install replacement into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
  - 1. Maintain joint width for replacement units to match existing joints.
  - 2. Use setting buttons or shims to set units accurately spaced with uniform joints.
- I. Lay replacement with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
  - 1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
  - 2. Rake out mortar used for laying before mortar sets according to Section 040120.64 "Masonry Repointing." Point at same time as repointing of surrounding area.
  - 3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
- J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
  - 1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.



### 3.3 MASONRY PATCHING

#### A. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of brick.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of brick. Shape and finish surface before or after curing, as determined by testing, to best match existing brick.
8. Keep each layer damp for 72 hours or until patching compound has set.

### 3.4 FINAL CLEANING

- #### A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.
1. Do not use metal scrapers or brushes.
  2. Do not use acidic or alkaline cleaners.

END OF SECTION

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## SECTION 042000 - UNIT MASONRY

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Concrete masonry units including new interior partitions, infill, and replacement of damaged CMU.
2. Repair of damaged CMU not otherwise requiring replacement.
3. Clay face brick.
4. Mortar and grout.
5. Masonry-joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

## B. Products Installed but not Furnished under This Section:

1. Steel lintels in unit masonry.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples for Verification: For each type and color of the following:

1. Clay face brick, in the form of straps of five or more bricks.
2. Special brick shapes.
3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
4. Weep holes and cavity vents.
5. Accessories embedded in masonry.

## 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

- B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Clean one-half of exposed faces of panels with masonry cleaner indicated.

5. Protect approved sample panels from the elements with weather-resistant membrane.
6. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
  - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.6 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
  2. Where one wythe of multi wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  2. Protect sills, ledges, and projections from mortar droppings.
  3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
  - 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

### 2.3 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
  - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
  - 2. Provide square-edged units for outside corners unless otherwise indicated.

## B. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Lightweight except normal weight where indicated on Structural Drawings.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

## 2.4 BRICK

## A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

## B. Clay Face Brick: Facing brick complying with ASTM C216. Match existing brick.

1. Where shown to "match existing," provide face brick matching color range, texture, and size of existing adjacent brickwork.

## 2.5 MORTAR MATERIALS

## A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

## B. Hydrated Lime: ASTM C207, Type S.

## C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

## D. Masonry Cement: ASTM C91/C91M.

## E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

## F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
2. Colored Masonry Cement:
3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

## 2.6 REINFORCEMENT

A. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Stainless steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Wire Size for Veneer Ties: 0.187-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

## 2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Stainless Steel Wire: ASTM A580/A580M, Type 304.
2. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
3. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

C. Adjustable Masonry-Veneer Anchors:

1. Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch-thick steel sheet, galvanized after fabrication.

3. Fabricate wire ties from 0.25-inch-diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section with screw holes top and bottom, with projecting tabs having holes for inserting vertical legs of wire tie formed to fit anchor section.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Heckmann Building Products, Inc.; 213 with 282.
    - 2) Hohmann & Barnard, Inc; Thermal Wing Nut Anchor.
    - 3) Wire-Bond; RJ-711 (#2401).
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch wide by 3-5/8 inches long, stamped into center to provide a slot between strap and base for inserting wire tie.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Heckmann Building Products, Inc.; 315-D with 316.
    - 2) Hohmann & Barnard, Inc; DW-10HS.
    - 3) Wire-Bond; 1004, Type III.
6. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, 1-1/4 inches wide by 6 inches long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch wide by 6 inches long, stamped into center to provide a slot between strap and base for inserting wire tie. Self-adhering modified bituminous gasket fits behind anchor plate and extends beyond pronged legs.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) Hohmann & Barnard, Inc; DW-10-X.
    - 2) Wire-Bond; 1004X, Type III X.
7. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.

## 2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing. Coordinate with Section 076200 "Sheet Metal flashing and Trim" and Section 077100 "Roof Specialties" as applicable to Project.



4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  5. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  6. Fabricate metal expansion-joint strips in metal flashing from stainless steel.
  7. Solder metal items at corners.
- B. Flexible Flashing: Use the following unless otherwise indicated:
1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Carlisle Coatings & Waterproofing Inc; CCW-705-TWF Thru-Wall Flashing.
      - 2) GCP Applied Technologies Inc.; Perm-A-Barrier Wall Flashing.
      - 3) Polyguard Products, Inc.; Polyguard 400.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application: Unless otherwise indicated, use the following:
1. Where flashing is indicated to receive counterflashing, use metal flashing.
  2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal drip edge.
  4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
1. Solder for Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- F. Termination Bars for Flexible Flashing: Aluminum sheet 0.064 inch by 1-1/2 inches with a 3/8-inch sealant flange at top.
- 2.9 MISCELLANEOUS MASONRY ACCESSORIES
- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:
  - 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Advanced Building Products Inc.; Mortar Break Weep Mesh.
      - 2) CavClear/Archovations, Inc.; CavClear Weep Vents.
      - 3) Mortar Net Solutions; Mortar Net Weep Vents.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Advanced Building Products Inc.;Mortar Maze or Mortar Break DT.
    - b. Heckmann Building Products, Inc.; WallDefender.
    - c. Hohmann & Barnard, Inc; Mortar Trap.
    - d. Mortar Net Solutions; Mortar Net with Insect Barrier.
    - e. Wire-Bond; Cavity Net DT.
  - 2. Configuration: Provide one of the following:
    - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
    - b. Strips, not less than 1-1/2 inches thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

## 2.10 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

## 2.11 MORTAR AND GROUT MIXES

- A. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.

3. For reinforced masonry, use portland cement-lime or masonry cement mortar.
  4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
  2. For reinforced masonry, use Type M or Type S.
  3. For mortar parge coats, use Type S.
  4. For exterior, above-grade, load bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
  5. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- C. Pigmented Mortar: Use colored cement product.
1. Pigments shall not exceed 10 percent of portland cement by weight.
  2. Mix to match Architect's sample.
  3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Clay face brick.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  2. Verify that foundations are within tolerances specified.
  3. Verify that reinforcing dowels are properly placed.
  4. Verify that substrates are free of substances that impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

### 3.3 TOLERANCES

#### A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.

#### B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

#### C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/16 inch, with a maximum thickness limited to 5/16 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 1/4 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/16 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/16 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### 3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated on Drawings, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- B. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- C. Cut joints flush where indicated to receive waterproofing, cavity wall insulation, or air barriers unless otherwise indicated.

### 3.6 ANCHORED MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  2. Embed tie sections in masonry joints.
  3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
- B. Provide not less than 2 inches of airspace between back of masonry veneer and face of sheathing or insulation.
1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.
- 3.7 CONTROL AND EXPANSION JOINTS
- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints in brick as follows:
1. Build in compressible joint fillers where indicated.
- C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.
- 3.8 LINTELS
- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
- 3.9 FLASHING, WEEP HOLES, AND CAVITY VENTS
- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal

- penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
  3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
  5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
  6. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
  2. Space weep holes 24 inches o.c. unless otherwise indicated.
- E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- 3.10 REPAIRING, POINTING, AND CLEANING
- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
7. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.11 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove masonry waste, and legally dispose of off Owner's property.

END OF SECTION



## SECTION 042200 - CONCRETE UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Mortar and grout.
  - 3. Steel reinforcing bars.

#### 1.3 DEFINITIONS

- A. Retain definitions remaining after this Section has been edited.
- B. CMU(s): Concrete masonry unit(s).
- C. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops net-area compressive strengths at 28 days as indicated on Drawings
  - 1. Net-area compressive strength of masonry shall be determined from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:
  - 1. Masonry units. Include material test reports substantiating compliance with requirements. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.

3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  4. Grout mixes. Include description of type and proportions of ingredients.
- C. Reinforcing bar shop drawings
  - D. Joint reinforcement product data.
  - E. Anchors, ties, and metal accessories product data.
  - F. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
    1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
    2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
  - G. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
  - H. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
- 1.7 QUALITY ASSURANCE
- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
  - B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
  - C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
  - D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
  - E. It is the Contractor's responsibility to engage a qualified Testing Agency for the monitoring of proportioning, mixing, and consistency of mortar and grout on-site and to provide strength testing per Section 3.08
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

#### 1.9 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.
- B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

### 2.2 CONCRETE MASONRY UNITS

- A. CMUs: ASTM C 90, Type N-1.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as required for project designated  $f'm$ 
    - a. For  $f'm = 1500$  psi, provide a minimum 1900 psi compressive strength
    - b. For  $f'm = 2000$  psi, provide a minimum 2800 psi compressive strength.
  - 2. Density Classification: Normal weight
  - 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
  - 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
  - 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

### 2.3 MASONRY LINTELS

- A. General: Provide one of the following:
- B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.
- C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.
- D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

### 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.

- E. Mortar Cement: ASTM C 1329.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
- G. Aggregate for Mortar: ASTM C 144.
- H. Aggregate for Grout: ASTM C 404.
  - 1. Maximum size shall be 3/8"
- I. Water: Potable.
- J. Mortar and grout

## 2.5 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M Grade 60
- B. Horizontal Joint Reinforcement, ASTM A82
  - 1. 9-gage truss-type, galvanized.

## 2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Pre-molded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

## 2.7 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use portland cement-lime mortar unless otherwise indicated.
  - 3. For exterior masonry, use portland cement-lime mortar.
  - 4. For reinforced masonry, use portland cement-lime mortar.
  - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
  - 1. For reinforced masonry, use Type S
- D. Grout for Unit Masonry: Comply with ASTM C 476.
  - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
  - 3. Provide grout with a slump of 8 to 10 inches as measured according to ASTM C 143/C 143M.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Provide and install temporary bracing required insuring stability of all walls during construction and until erection of attached structural framing is completed. Temporary shoring is the responsibility of the Contractor.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

#### 3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Masonry: Unless otherwise indicated, lay exposed masonry in running bond. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Revise first paragraph below if flexible perimeter joint or thermal break is required.
- F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- E. Full head and bed joints shall be provided.
- F. Mortar shall be mixed onsite.
- G. Provide masonry veneer anchors at 16 inches OC set on coursing and attached to all beams, columns, partitions, and walls abutting or embedded in masonry unless noted otherwise on Architectural and Structural Drawings.

### 3.5 LINTELS AND BOND BEAMS

- A. Provide lintels and bond beams as indicated on Drawings
- B. Horizontal reinforcing bars in bond beams and/or lintel blocks are to be continuous and solid grouted in place and to extend not less than 20 bar diameters or 16 inches (whichever is greater) past the opening face.
- C. Bond beams are to be continuous at control joints, unless otherwise noted.

### 3.6 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  1. Space reinforcement not more than 16 inches o.c.



2. Space reinforcement not more than 8 inches o.c. in corners and intersections
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. All bars shall be tied at splices.
  3. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
  4. All formwork is the responsibility of the Contractor.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
  1. Vertical reinforcing bars may be spliced in 6ft and 8ft lengths provided that the splices in adjacent bars are staggered and arranged so that not more than 1/3 of the total number of bars are spliced at any location and not more than 1/2 of the total number of bars are spliced at mid-height of the wall.
  2. All bars shall be tied at splices.
  3. Vertical bars shall be held in position at top and bottom and at intervals no exceeding 8ft with a minimum clearance of 1/4 inch from the edge of masonry and not less than one bar diameter between bars.
  4. Bars shall lap above foundation level and between floors.
  5. Reinforcement shall be continuous from level to level.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches for low lift grouting
  3. If high lift grouting, provide clean-outs and adequate vibration. Max grout pour height for high lift grouting is 12 ft.
  4. All cells containing vertical reinforcing steel, lintel beams and bond beams are to be solid grouted.
  5. Grouted cell locations shall be continuous from level to level.

### 3.8 FIELD QUALITY CONTROL

- A. EOR may perform periodic, visual inspections in accordance with the General Notes on the Drawings. Any inspection shall not, in any way, relieve the Contractor of the final responsibility

of the installation of the masonry walls with accordance with the Contract Drawings and Specifications

1. The Engineer may observe the placement of mortar, grout, and masonry units and the placement of reinforcing steel for compliance with the Contract Documents with periodic pre-pour inspection as follows with ACI 530 Quality Assurance Level B: the first pour, minimum (1) additional pre-pour inspection for subsequent pours, and (1) final pre-pour inspection for the top of wall.
  2. Visual Inspection is intended to provide quality control and does not alleviate the Contractor from final responsibility of installation of the masonry per drawings or guarantee the Contractor's work
  3. First course grout placement shall not occur until the EOR has performed aforementioned visual inspection.
- B. The Testing Agency shall monitor the proportioning, mixing, and consistency of mortar and grout in accordance with ACI 530 Quality Assurance Level B.
- C. Grout Prism Compressive Testing
1. One set shall equal (3) prisms each for testing at (7) days and (28) days, plus retain (3) additional prisms for any required additional testing.
  2. One set of tests for each 3000 sq. ft. of wall area or portion thereof, but not less than (2) tests for each testing period or (1) test per day of grout placement.
  3. Build and test masonry grout prisms in accordance with ASTM C1019.
  4. Build grout prisms in the presence of the Testing Agency.
- D. Mortar Cube Testing
1. One set shall equal (3) prisms each for testing at (7) days and (28) days, plus retain (3) additional prisms for any required additional testing.
  2. One set of tests for each 3000 sq. ft. of wall area or portion thereof, but not less than (1) test for each mortar type.
  3. Build masonry mortar cubes in accordance with ASTM C270 in the presence of the Testing Agency.

### 3.9 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

END OF SECTION 042200

## SECTION 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Contract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
  - 1. Structural steel framing members, support members, bracing members and connections.
  - 2. Base plates, leveling plates, anchor bolts, leveling nuts, shear stud connectors, deformed bars welded to structural steel, and bolts.
  - 3. Grouting under base plates.
  - 4. Verification of anchor bolt setting and levels to assure adequate fit of the steel work.
- C. Related Sections:
  - 1. Division 05 Section "Steel Roof Decking".
  - 2. Division 05 Section "Steel Joists".

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. ASTM International:
  - 1. ASTM A27 / A27M Standard Specification for Steel Castings, Carbon, for General Application
  - 2. ASTM A47 / A47M Standard Specification for Ferritic Malleable Iron Castings
  - 3. ASTM A53 / A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 4. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
  - 5. ASTM A123 / A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 6. ASTM A153 / A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - 7. ASTM A283 / A283M Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
  - 8. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
  - 9. ASTM F3125 Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

10. ASTM A385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
11. ASTM A500 / A500M Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
12. ASTM A525 General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
13. ASTM A36 / A36M Standard Specification for Carbon Structural Steel
14. ASTM A572 / A572M Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
15. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
16. ASTM A992 / A992M Standard Specification for Structural Steel Shapes
17. ASTM D2092 Recommended Practices for Preparation of Zinc-Coated Steel Surfaces for Painting
18. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code

D. American Institute of Steel Construction (AISC):

1. AISC 303 – Code of Standard Practice for Steel Buildings and Bridges except the following shall be added to 3.1 (f): Horizontal and vertical dimensions may not be shown entirely on the Structural Drawings.
2. AISC 360 – Specification for Structural Steel Buildings
3. AISC - Steel Construction Manual
4. RCSC -Research Council on Structural Connections "Specification for Structural Joints Using High-Strength Bolts

### 1.3 DEFINITIONS

- A. Heavy Shapes: ASTM A6, Group 3 shapes with flanges thicker than 1-1/2 inches (12.5 mm), Group 4 shapes, and Group 5 shapes; welded built-up members with web or flange plates exceeding 1-1/2 inches (12.5 mm) in thickness

### 1.4 SUBMITTALS

- A. Shop drawings for structural steel fabrications shall be submitted for review prior to fabrication. Examples include, but are not limited to:
1. Complete fabrication and erection plans and procedures giving full information on aspects of the erection which will affect alignment, plumb and dimensional accuracy of the structure.
  2. Connections including size and spacing of bolts and welds.
  3. Indicate profiles, sizes, spacing, and locations of structural members, openings, camber and attachments. Indicate welded connections with AWS welding symbols. Indicate net weld lengths. Details of welding materials, equipment, sequence and technique to be used. Shop and erection details incorporating seismic critical welds shall include explicit references to corresponding weld procedure specifications.
  4. The Contractor shall survey, review and confirm as-built conditions prior to developing shop drawings. Field modifications to suit as-built conditions shall be at the Contractor's expense.
  5. Stamped drawings by an Engineer licensed in Louisiana shall be provided for:
    - a. Moment connections (beam to beam, beam to column)

- b. Column splices
- c. Stair stringers, handrails, and landings.
- 6. Corrections or comments made on shop drawings during review do not relieve contractor from compliance with the requirements of the drawings and specifications. The review is only an examination of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The contractor is responsible for confirming and correlating all sizes, quantities, and dimensions; selecting fabrication and erection processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.
- B. Welder Performance Qualification Records (WPQR): Contractor shall submit WPQR for each shop and field welder, and for the Certified Welding Inspector to the Architect for review.
  - 1. It is the Erector's responsibility to engage a qualified Certified Weld Inspector (CWI) if one is not employed internally.
- C. Welders' Certificates: Documentation certifying each welder and the Certified Welding Inspector employed on the work meets AWS qualifications.
- D. Manufacturer's Certificates: Submit certification that manufactured products (including bolts, nuts and washers) meet or exceed specified requirements. Manufactured products are to be delivered in unopened containers. Certification numbers must appear on product containers for bolts, nuts and washers and the numbers shall correspond to the identification numbers on the Manufacturer's Certificate. The Manufacturer's symbol and grade markings must appear on bolts, nuts and washers. Submit manufacturer's certification that structural shapes contain specified percentage recycled material.
- E. Product data: Submit certification that manufactured products meet or exceed specified requirements.
  - 1. Weld filler material including filler metal Charpy V-Notch test values, electrodes, fluxes and shield gases.
  - 2. Prime paint.
  - 3. Welded studs.
  - 4. Cold-galvanizing compound for touch-up, as required.
- F. Mill Test Reports: Submit mill test reports indicating structural strength, destructive and nondestructive test analysis and chemical analyses from each heat of steel used in the work.

#### 1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC specifications.
- B. Welders shall be qualified in accordance with AWS D1.1 for each process, position and joint configuration.
- C. Maintain one copy of each referenced document on site.
- D. Survey anchor bolts for location and elevation prior to casting concrete.
- E. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-certified plant, category STD.

- F. Erector Qualifications: Company with a documented experience in performing the work of this Section and participates in the AISC Quality Certification program and is designated as AISC-certified erector, category CSE.
- G. The design of connections not detailed on the Drawings shall be under the direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Louisiana.

#### 1.6 TESTS AND INSPECTIONS

- A. Welding Tests and Inspections
  1. All welds shall be visually inspected by an AWS Certified Weld Inspector in accordance with AWS D1.1 and in accordance with AWS B1.1 "Guide for Visual Examination of Welds"
  2. It is the Fabricator's responsibility to provide a CWI meeting the minimum requirements specified in AWS D1.1, Section 6.
  3. Additionally, 25% of full penetration welds shall be tested by ultrasonic testing in accordance with ASTM E164 and AWS D1.8
  4. Additionally, 100% of welds in moment connections shall be tested by ultrasonic testing in accordance with ASTM E164.
  5. Additionally, 100% of welds in column splice connections shall be tested by ultrasonic testing in accordance with ASTM E164.
- B. High-Strength Bolting Tests and Inspections
  1. All high strength bolts ASTM F3125 shall be manufactured, installed, and field tested in accordance with the "Specification for Structural Joints using High Strength Bolts" by RCSC, latest edition.
  2. It is the responsibility of the Erector to comply with the minimum requirements of the RCSC for visual inspections.

#### 1.7 CONTRACTOR'S ENGINEERING SERVICES

- A. General: Where engineering services are required herein and excluded from EOR's contract, the Contractor shall retain a Professional Civil or Structural Engineer, referred to herein as the Contractor's Engineer. Documents prepared by the Contractor's Engineer shall be stamped and signed by a Professional Engineer licensed in the state where the project is located.
- B. The steel structure is a non-self-supporting steel frame and is dependent upon diaphragm action of the metal roof deck and attachment to the masonry walls for stability and for resistance to wind and seismic forces. Provide all temporary supports required for stability and for resistance to wind and seismic forces until these elements are complete and are capable of providing this support. All temporary shoring and bracing during erection is the responsibility of the Erector and Contractor.
- C. The Fabricator shall be responsible for the design and adequacy of all connections that are not designed or fully detailed on the Contract Documents. Shop Drawings, depicting the configuration and fabrication details, along with calculations signed and sealed by a Registered Professional Engineer working for the Fabricator licensed to practice in the state in which the project is located, shall be submitted to the structural Engineer of Record for review. Delegated design connections include, but are not limited to, moment connections shown on plans and column splices as requested by Erector.

1. All beam to column moment connections shall be designed for the minimum service reaction indicated on plans in combination with a 10 kip axial force (acting in both tension and compression).
- D. Metal stairs shown on plans are for illustrative purposes only. The Fabricator shall be responsible for the design of metal stairs. Shop Drawings, depicting the configuration, connection, and fabrication details, along with calculations signed and sealed by a Registered Professional Engineer working for the Fabricator licensed to practice in the state in which the project is located, shall be submitted to the structural Engineer of Record for review of design intent.
- E. Alternate connection details may be used if such details are submitted to the engineer for review and approval. However, the engineer shall be the sole judge of acceptance and the Contractor's bid shall anticipate the use of those details shown on the drawings. The Contractor is responsible for the design of such alternate details which they propose and provide stamped drawings for approval.
- F. All handrails shall be designed per IBC Chapter 16 including a 200 lb concentrated point load and, in public spaces, a 50 pound per linear foot line load. See Chapter 16 for all design requirements for handrails. Signed and sealed calculations by an Engineer licensed in the State where the project is located shall be provided by the Fabricator.
- G. All vehicle barriers shall be designed per IBC Chapter 16 including a 6000 lb concentrated point load. See Chapter 16 for all design requirements for vehicle barriers. Signed and sealed calculations by an Engineer licensed in the State where the project is located shall be provided by the Fabricator.

#### 1.8 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on the Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Structural Steel Members: A992 for rolled wide flange shapes and, for other rolled shapes and plate.
- B. Plate, bars and channels: ASTM A36 unless otherwise noted on the drawings. Plates 2 inch thick and greater shall have Charpy V-Notch toughness of 20 ft-lb at 70 degrees F tested at any location permitted by ASTM A673.
- C. Structural Tubing: ASTM A500, Grade B. Structural tubing shall be new and contain a minimum of 75 percent recycled post consumer steel.
- D. Pipe: ASTM A53, Type E or S, Grade B. Pipe shall be new and contain a minimum of 75 percent recycled post consumer steel and not more than 0.05 percent sulphur.
- E. Shear Stud Connectors: ASTM A108, Grades 1010 through 1020 inclusive. Connectors shall be free of defects, cracks or bursts deeper than half the thickness from the periphery of the head to the shaft. After welding, studs will be the length shown on the drawings.



- F. Threaded Stud Connectors: Threaded studs in structural steel connections shall be reduced base studs conforming to ASTM A108, Grades 1010 through 1020 inclusive. After welding, studs will be the length shown on the drawings.
- G. Bolts and Nuts: Bolts in structural steel connections shall be ASTM F3125 Grade A325, Type I unless designated as Grade A490 on the drawings. Nuts shall be ASTM A563 Grade C or DH. Patented, high strength steel connectors conforming to ASTM F1852 must be submitted for approval by the Architect and will not be permitted at slip critical bolted connections. Where galvanized connectors are called for on the drawings, they shall be galvanized in accordance with ASTM A153. Bolts conforming ASTM A307 and nuts conforming to ASTM A563 may be used in stair, handrail, miscellaneous steel and timber connections.
- H. Washers shall be flat and either circular, square or rectangular conforming to ASTM F436 Type 1. The finish of washers is to match the nut. Grade A325 bolts shall have washers under the head and Grade A490 bolts shall have hardened washers under the head and the nut.
- I. Threaded Anchor Rods: ASTM F1554 36-ksi yield strength, unless otherwise designated on the drawings.
  - 1. Finish: Hot dip zinc coating.
  - 2. Grout: Nonmetallic, shrinkage resistant, non-corrosive, non-staining, factory-packaged complying with ASTM C1107.
- J. Clevises and Turnbuckles: Cold-finished carbon steel bars, ASTM A108, Grade C1035.
- K. Welding Materials: Filler metals shall conform to Table 4.1 of AWS D1.1. Electrodes and equipment settings shall be as recommended by the filler metal manufacturer for the position, thickness and conditions of use. electrodes and filler metal shall be low hydrogen types. FCAW wire diameter shall not exceed the values in Section 4.14.1 of AWS D1.1.
- L. Sliding Bearing Plates: Teflon coated.
- M. Touch-up Primer for Galvanized Surfaces: Zinc rich type.

## 2.2 CONNECTIONS

- A. Unless otherwise noted on the drawings, shop connections shall be welded and field connections, except moment connections, shall be bolted. Weld only in accordance with approved welding procedures.
- B. Unless otherwise noted on the drawings, every weld shall develop the full strength of the lesser of the members it joins.
- C. All butt, groove, or bevel welds shall be complete, full penetration.
- D. Welding electrodes shall be E70XX for manual arc welding and F7X-EXXX for submerged arc welding.
- E. Minimum weld size shall be 3/16" unless noted otherwise.
- F. Unless otherwise noted on the drawings, bolted connections shall be 3/4-inch diameter F3125 Grade A325; connections shall have a minimum of two bolts. Shoulder bolts with hex nut and

lock washers shall be used in slotted connections with the washer covering the slot in positions. Bolts shall be assumed snug-tightened unless noted otherwise.

- G. Oversize holes shall not be allowed without approval of the EOR. If oversize holes are elected and approved, bolts shall be slip-critical.
  - H. Unless connections are detailed on the drawings, the Contractor is responsible for the design of connections and shall submit stamped Shop Drawings, by an Engineer licensed in Louisiana, for review.
  - I. All elements of a connection shall be designed to resist the loads and moments shown on the drawings; if the reaction or load is not shown on the drawings, connections are to be designed as follows:
    - 1. Beam connections are to be designed to resist one half the allowable load for the appropriate span given in the Tables 3-6 through 3-9 in the AISC Manual of Steel Construction. Beam connections will be in accordance with the AISC Manual of Steel Construction. The minimum connection angle length will be half the depth of the beam depth.
    - 2. Horizontal and vertical bracing connections shall have a minimum of two bolts.
  - J. All connections shall be symmetrical about the axis of the member connected. Provide only one grade of bolt for each bolt diameter to be used in the connections. Do not mix grades of bolts.
  - K. Gusset plates connecting horizontal and vertical bracing to beams and/or columns shall be connected to both adjacent members; where this is not practical, provision shall be made for the moment induced by the eccentricity of the load to the work point of the connection. Gusset plates for horizontal bracing shall be located within the top two rows of bolts of beam connection angles, unless otherwise noted on the drawings. The minimum thickness of gusset plates in single shear shall be 5/16-inch for bolts in single shear and 3/8-inch for bolts in double shear.
  - L. Oversize holes for anchor bolts may be used with field welded washer plates. Anchor bolts for each column shall be furnished with a 1/8 thick sheet metal template.
  - M. Dissimilar metals shall be treated or properly separated to prevent galvanic and/or corrosive effects.
  - N. Where possible, all bolt holes in structural steel shall be drilled or punched in the shop. Any holes required to be made at the project site shall be mechanically drilled or punched. No burning of holes shall be allowed.
- 2.3 FABRICATION
- A. Fabricate structural steel in accordance with the applicable provisions of the AISC Specifications for Structural Steel Buildings. Where practical, fabricate and assemble in the shop.
  - B. Obtain field measurements necessary for steel fabrication.
  - C. Perform high strength shop bolting in accordance with the appropriate ASTM specification. Complete high strength shop bolting before welding.

- D. Dimensional tolerances:
- E. Overall length of members with both ends milled may vary by 1/32-inch.
- F. Overall length of members without milled ends may vary by 1/16-inch for lengths less than 30 feet and 1/8-inch for lengths 30 feet and over.
- G. Where structural joints are welded, the detail of the joints, welding technique, weld quality and appearance, and methods for correcting defective welds shall conform to the AISC Code of Standard Practice and AWS D1.1. Welding procedure and sequence shall conform to AWS B2.1. Surfaces to be welded shall be clean and free of rust, paint, or galvanizing. Burned or flame cut edges shall be chipped clean and wire brushed.
- H. Where milling is indicated on the drawings, the contact surfaces shall be machined true to obtain full and complete contact.
- I. Structural members are selected from generally available rolled sections; however, if the specified sections are not available, the Contractor shall provide sections with equivalent physical properties after approval by and at no additional cost to the Architect.
- J. Shear studs shall not be installed in the shop.
- K. All steel shall be painted with shop standard primer unless noted otherwise.
- L. Splices in structural steel not shown on the structural drawings will not be accepted without specific approval of the Structural Engineer. Submitted splices shall be designed the Fabricator's delegated design engineer and stamped by an Engineer licensed in Louisiana.
- M. The General Contractor and Steel Erector shall notify the Architect of any fabrication or erection errors or deviations and receive written approval before any field corrections are made.

#### 2.4 FINISH

- A. Shop prime structural steel members unless noted otherwise. Apply two coats of different colored primer to areas which will be inaccessible after erection or assembly. Do not prime surfaces that will be fireproofed, galvanized, fully embedded in concrete or mortar, within 3 inches of field welds, or on the faying surface of high strength bolted friction connections.
  - 1. Lead and chromate free, non-asphaltic, rust-inhibiting primer complying w/ MPI #79 and compatible w/ any top coat.
  - 2. SSPC-SP2 surface preparation or better.
  - 3. Extend briming of partially embedded member minimum 2in.
- B. Galvanize structural steel members indicated on the Drawings as galvanized in accordance with ASTM A123 and A385 after fabrication. Prepare galvanized surfaces to be painted in accordance with ASTM D2092 and shop coat with a compatible primer. Repair damaged galvanizing in accordance with ASTM A780.
- C. High Performance Coatings - All exposed or visible structural steel not designated to be galvanized shall receive one or more coats of paint after fabrication in accordance with all requirements of the Steel Structures Painting Council's requirements for Zone 1A for interior

steel or Zone 1B for exterior steel. All such paints shall be compatible with the finish coat as specified in Division 9.

## 2.5 PREPARATION

- A. Provide anchor bolts and other items embedded in concrete.
- B. Furnish and install temporary supports and internal braces necessary to support structural steel during erection. Temporary supports and braces shall be adequate for anticipated wind, seismic, equipment and erection loads. Remove temporary shoring after the steel erection is complete.
- C. After completion of welds, remove weld tabs (spillage dams) in accordance with AWS D1.1 provision for dynamically loaded structures. After completion of full penetration groove welds, remove backing bars in accordance with AWS D1.1 provision for dynamically loaded structures, inspect the weld and reinforce the groove weld with a fillet weld. Peening of thick welds shall be performed in accordance with AWS D1.1.

## 2.6 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means Contractor accepts that existing conditions meet the requirements for installation.
- C. The General Contractor and/or Steel Erector shall notify the Architect of any fabrication or erection errors or deviations and receive written approval before any field corrections are made.

## 2.7 ERECTION

- A. Erect structural steel in accordance with the AISC Specifications for Structural Steel Buildings, except as modified herein. Where members cannot be properly assembled due to mis-fabrication or deformation due to handling or transportation, the condition shall be reported to the Architect with a proposed method of correction for approval.
- B. During erection beams and vertical bracing are to be secured with at least two bolts prior to releasing the hoisting cable.
- C. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Perform high strength bolting in accordance with the appropriate ASTM specification. Complete high strength bolting before field welding.
- E. Do not field cut or alter structural members without approval of the Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

- G. Grout base plates with non-shrink grout. Clean concrete bearing surfaces from bond-reducing materials, and roughen if necessary to improve bond to surfaces. Clean the bottom surface of base plate. Set base plate on wedges or other adjustable devices. After the base plate has been positioned and plumbed, tighten the anchor bolts. Pack grout solidly between the bearing surfaces to ensure that no voids remain complying with manufacturer's instructions for non-shrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.
  - H. Where field welding to existing structural members is required, the Contractor shall confirm the weldability of the existing steel by cutting or drilling samples and having them tested by the Contractor's Independent Testing Laboratory. The testing laboratory shall recommend the location for taking samples, provide a report on weldability, recommend the type of electrode and weld and inspect the final welds. The Contractor will be responsible for preparing the existing steel for welding and touch of the surfaces. Use low hydrogen electrodes when welding to existing steel.
  - I. Existing framing requiring welding shall be thoroughly cleaned to ensure proper welding.
  - J. Provide temporary shoring when welding to existing steel.
  - K. Use low-hydrogen electrodes when welding to existing steel.
  - L. Field welded surfaces within 4 inches of weld shall be cleaned and ground smooth. After welding, coat the exposed area with appropriate primer/paints as specified.
  - M. Spandrels and columns adjacent to masonry shall have adjustable masonry ties.
  - N. Main support members for the metal deck are shown. During preparation, submission, and review of shop drawings, any additional angles or miscellaneous attachment details required to support the metal deck at the required elevation shall be provided by the Structural Steel Contractor.
  - O. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
  - P. Structural elements shall be fabricated and assembled in the shop to the greatest extent possible. All field connections shall be bolted unless shown otherwise on the structural drawings.
  - Q. No flame cutting or enlarging will be allowed without specific approval of the Structural Engineer.
- 2.8 ERECTION TOLERANCES
- A. Tolerances shall be in accordance with the AISC Code of Standard Practice. Crane rail tolerances shall comply with CMAA Specification 70.

END OF SECTION 051200

## SECTION 052100 - STEEL JOISTS

### 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. K-series steel joists.
  - 2. K-series steel joist substitutes.
  - 3. Ecospan composite steel joists.
  - 4. Joist accessories.
- B. Related Requirements:
  - 1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

#### 1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product.
- B. Shop Drawings:
  - 1. Include layout, designation, number, type, location, and spacing of joists.
  - 2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
  - 3. Delete subparagraph below if bearing plates are specified in Section 05500 "Metal Fabrications."
  - 4. Indicate locations and details of bearing plates to be embedded in other construction.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Manufacturer certificates.
- C. Mill Certificates: For each type of bolt.

- D. Comprehensive engineering analysis of special joists and Ecospan composite joists signed and sealed by the qualified professional engineer licensed in the project location responsible for its preparation.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."
  - 1. Manufacturer's responsibilities include providing professional engineering services for designing special joists and Ecospan to comply with performance requirements.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists, Ecospan joists, and connections capable of withstanding design loads indicated.
  - 1. Use design loads reported on Design Drawings.
  - 2. Design special joists to withstand design loads with live-load deflections no greater than designated on the Design Drawings.

#### 2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
  - 1. Joist Type: K-series steel joists.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Do not camber joists.

## 2.3 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

## 2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of diagonal bridging of material, size, and type required by SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. ASTM A 307 defines the term "studs" as including stud stock and threaded rods.
- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
- D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts; ASTM A 563 (ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M) hardened carbon-steel washers.
- E. Galvanizing Repair Paint: ASTM A 780
- F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

## 2.5 SHOP PAINTING

- A. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.



- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.
- C. Before installation, splice joists delivered to Project site in more than one piece.
- D. Space, adjust, and align joists accurately in location before permanently fastening.
- E. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
- F. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- G. Bolt joists to supporting steel framework using carbon-steel bolts.
- H. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

### 3.3 FIELD QUALITY CONTROL

- A. Visually inspect field welds according to AWS D1.1/D1.1M. All inspection shall be made by an AWS Certified Weld Inspector retained by the Erector.
- B. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.
- C. Perform additional testing to determine compliance of corrected Work with specified requirements.

### 3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
  - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
  - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.

END OF SECTION 052100

## SECTION 053100 - STEEL DECK

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
- B. Roof deck.
- C. Metal form deck.
- D. Supplementary framing for openings up to and including 18 inches.
  - 1. Bearing plates and angles.
- E. Related requirements:
- F. Section 033000 - Cast-in-Place Concrete: Concrete topping over metal deck.
- G. Section 051200 - Structural Steel: Support framing for openings larger than 18 inches.
- H. Section 052100 - Steel Joists: Support framing for openings larger than 18 inches.

#### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM A 36/A 36M -Specification for Carbon Structural Steel; latest edition
  - 2. ASTM A108. Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; latest edition
  - 3. ASTM A 123/A 123M -Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel. Products; latest edition
  - 4. ASTM A 653/A 653M -Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; latest edition
  - 5. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened; latest edition
- B. AWS:
  - 1. AWS D1.1/D1.1M -Structural Welding Code - Steel; American Welding Society; 2010.
  - 2. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 2008.
- C. Other Standards:
  - 1. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
  - 2. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.
  - 3. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); The Society for Protective Coatings; 2002 (Ed. 2004).
  - 4. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

### 1.3 SUBMITTALS

- A. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Submit manufacturer's installation instructions.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

## **PART 2 - PRODUCTS**

### 2.1 MANUFACTURERS

- A. Steel Deck:
  - 1. Nucor-Vulcraft Group: [www.vulcraft.com](http://www.vulcraft.com).

### 2.2 STEEL DECK

- A. Roof Deck: See Design Drawings.
- B. Metal Form Deck: See Design Drawings.
- C. Metal Composite Deck: See Design Drawings.
- D. Accessory Materials:
  - 1. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
  - 2. Welding Materials: AWS D1.1.
  - 3. Fasteners: Galvanized hardened steel, See Structural General Notes.
  - 4. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

## **PART 3 - EXECUTION**

### 3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.

### 3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. Fasten deck to structural steel framing in accordance with the Design Drawings.
- C. On wood surfaces provide minimum 4 inch bearing.
- D. At mechanically fastened male/female side laps and end laps, fasten as per the structural drawings.
- E. At deck openings from 6 inches to 18 inches in size, provide minimum 3 x 3 x 1/4 inch steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and mechanically attach to deck at each flute.
- F. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- G. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- H. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.

END OF SECTION 053100

## SECTION 054000 - Cold-Formed Metal Framing

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Related Documents:
  - 1. Drawings and general provisions of the Subcontract apply to this Section.
  - 2. Review these documents for coordination with additional requirements and information that apply to work under this Section.
- B. Section Includes:
  - 1. Load-bearing and exterior cold-formed framing
  - 2. Formed steel shaped sections, solid webs; 14-gauge thickness and lighter for load bearing and non-load bearing exterior framing with floor and ceiling track, bracing, furring, and bridging
- C. Related Sections:
  - 1. Division 09 Gypsum Board Assemblies
  - 2. Division 04 Masonry Veneer

#### 1.2 REFERENCES

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. ASTM International:
  - 1. ASTM A36 / A36M -  
Standard Specification for Carbon Structural Steel
  - 2. ASTM A90 / A90M -  
Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
  - 3. ASTM                   A                                   153/A                                   153M                                   -  
Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2005.
  - 4. ASTM A653 / A653M -  
Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - 5. ASTM                   A                                   1008/A                                   1008M                                   -  
Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007a.
  - 6. 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; 2007.

- C. American Welding Society (AWS):
  - 1. AWS D1.3 -

Structural Welding Code – Sheet Steel

- D. AISI SG02-1 -

North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971 Steel Deck Institute (SDI):

### 1.3 SUBMITTALS

- A. Product Data for each product specified.
- B. Shop Drawings (if design not fully delineated on Contract Drawings): Indicate the following:
  - 1. Indicate component details, framing openings, bearing, anchorage, loading, temporary bracing, welds, type and location of mechanical fasteners, and accessories or items required of other work for complete installation.
  - 2. Detail stud, ceiling joist, and roof rafter layout.
  - 3. Provide calculations for loadings and stresses of any third party designed framing under the seal of a Professional Engineer licensed in Louisiana.
- C. Submit manufacturers installation instructions for securing studs to tracks and for other framing connections.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold formed framing from corrosion, deformation and other damage during delivery, storage and handling. Damaged framing will be rejected by the Architect and replaced at no additional cost to the Architect.
- B. Store cold formed framing off the ground and at a slight angle with a ventilated, waterproof covering.

## PART 2 - PRODUCTS

### 2.1 STEEL FRAMING

- A. Studs, Joists: Shape as detailed, depth to provide total wall thickness shown in conjunction with finish surfaces or cladding indicated. Thickness as required for design conditions; galvanized. See plans for more information.
  - 1. ASTM A653
  - 2. Minimum yield strength shall be 50,000 psi for 12, 14, and 16 gauge; 33,000 psi for 18 and 20 gauge.
- B. Track: Formed galvanized steel; channel shaped; same width as studs, for tight fit; solid web.
  - 1. ASTM A653
  - 2. Minimum yield strength shall be 50,000 psi for 12, 14, and 16 gauge; 33,000 psi for 18 and 20 gauge.

- C. The design presented on the Contract Drawings are based on light gage metal framing products manufactured by Clark Dietrich. Members by other manufacturer's may be supplied provided load carrying capacity based on manufacturer's standard load tables, and deflection characteristics equal or exceed those of materials specified and if approved by the Architect and EOR.

## 2.2 STEEL PURLINS AND GIRTS

- A. Purlins, Girts: Shape as detailed, depth to provide total wall thickness shown in conjunction with finish surfaces or cladding indicated. Thickness as required for design conditions; galvanized. See plans for more information.
  - 1. ASTM A570
  - 2. Minimum yield strength shall be 55,000 psi for 12, 14, and 16 gauge.
- B. Light gage metal roof framing (purlins and girts) properties are based on products manufactured by Nucor-Vulcraft. Members by other manufacturer's may be supplied provided load carrying capacity based on manufacturer's standard load tables, and deflection characteristics equal or exceed those of materials specified and if approved by the Architect and Structural Engineer.

## 2.3 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed galvanized sheet steel.
- B. Plates, Gussets, Clips: Galvanized formed steel, thickness determined for conditions encountered, manufacturer's standard shapes.
  - 1. All holes shall be filled.

## 2.4 FASTENINGS

- A. Self-drilling, self-tapping screws, bolts, nuts, and washers: Hot dip galvanized: ASTM A 90.
  - 1. Min. fastener size shall be #10 AISI-1022 steel screws having a minimum diameter out-to-out of threads = 0.190".
  - 2. Contractor shall refer to installation instructions published by the screw manufacturer and ASTM C954 for minimum spacing and edge distances requirements and torque requirements.
- B. Anchorage Devices: Power driven or powder actuated, drilled expansion bolts; or screws with sleeves.
- C. Welding: AWS D1.3.

## 2.5 FINISHES

- A. Galvanizing: The minimum requirements of ASTM C 955.
  - 1. Steel framing (studs, tracks, joists):
    - a. Not exposed to weather: G-60
    - b. Exposed to weather: G-185
  - 2. Accessories (hangers, clips, ties, anchors):
    - a. Not exposed to weather: G-60
    - b. Exposed to weather: G-185

- B. Primer: FS TT-P-645, touch-up for galvanized surfaces.

## 2.6 FABRICATION

- A. Galvanize, touch-up, and prime-paint metal materials used on exterior wall and soffit framing, and roof framing.
- B. Fabricate assemblies of sizes and profiles required, with joints fitted, and secured, reinforced, and braced to suit design requirements.

## 2.7 DESIGN

- A. All cold-formed framing not fully detailed on the drawings shall be designed by an Engineer registered in the State that project is located. Engineer Stamped Shop Drawings and calculations showing member sizes, locations, and connection details shall be submitted to the project EOR for approval.

# PART 3 - EXECUTION

## 3.1 ERECTION

- A. Install framing components, including wall studs, joists and purlins, in accordance with the manufacturer's instructions.
- B. The multiple pick method of erection (Christmas treeing) shall not be used.
- C. Flame cutting of cold formed sections is prohibited on the job site.
- D. Touch-up field welds and damaged galvanized surfaces with primer.
- E. Cutting shall be by saw, shear or plasma cutting equipment only.
- F. Wall Framing
  1. Place studs at 16 inches O.C. unless noted otherwise, not more than 2 inches from abutting walls, and at each side of openings. Connect studs to tracks using clips and ties, screws, or welding in accordance with manufacturer's instructions.
  2. Secure bottom and top tracks to floors and framing per Design Drawings or at a minimum 24" o.c. if not noted otherwise.
  3. Studs shall be plumbed, aligned, and securely attached to the flanges or webs of both upper and lower tracks.
  4. Where splicing of track is necessary between stud spacing, a piece of stud shall be placed between adjacent tracks and fastened by welds or screws to each side of the track, each end per Typical Details.
  5. Wall stud bridging shall be attached in a manner to prevent stud rotation. Bridging, of the type and spacing shown on the Contract or Shop Drawings shall be installed prior to loading. Bridging spacing shall be as required by design but shall not exceed 5'-0" O.C.
  6. Provide minimum bridging in all load-bearing walls regardless of being explicitly noted on the Drawings.
  7. Construct corners using at least three studs.



8. In non-loading bearing interior walls: Minimum double studs at door, window, and sidelite jambs. Install intermediate studs above and below openings to match wall-stud spacing.
9. Provision for structure vertical movement shall be provided where indicated on the plans using vertical slide clips or other means. Frame both sides of expansion joints with separate studs; do not bridge the expansion joints with stud system components.
10. Isolate the sides and top of anchored veneer from the structure so that lateral seismic and wind forces resisted by the structure are not imparted to the veneer. See architectural plans and specification for joints in the veneer and attachments to the walls.
11. In load-bearing walls and non-load-bearing exterior walls: Follow Design Drawings for header and jamb details. Install intermediate studs above and below openings to match wall-stud spacing.
12. Erect load bearing studs one-piece full-length. Splicing and wire tying of framing components is not permitted.
13. Axially loaded studs shall be installed in a manner which will assure that ends of the studs are positioned against the inside track web, prior to stud and track attachment. Studs shall be squarely cut and positively clamped and positioned until properly fastened.
14. Axially loaded studs shall be braced and reinforced to develop full strength to meet design requirements.
15. Light gage load-bearing and exterior framing is based on the final condition of the structure with the sheathing providing lateral bracing. Contractor shall provide temporary bracing of load-bearing stud flanges during construction that will reproduce the effect of sheathing. Temporary bracing is the responsibility of the Contractor and therefore at the discretion of the Contractor.
16. Make provisions for erection stresses. Provide temporary alignment and bridging and/or bracing.
17. Provide deflection allowance below supported horizontal building framing in ceiling or head track for non-load bearing framing.
18. Attach cross studs or furring channels to studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, grab bars, and other items anchored to partitions or walls.
19. Install framing between studs for attachment of electrical boxes and other mechanical and electrical items.
20. Wall sheathing shall be attached with long dimensions perpendicular to wall studs and staggered. Edges of panels shall bear on studs. Attach with self-tapping screws.

G. Floor and Roof Members

1. Set floor or ceiling joists parallel and level, with end bearing, lateral bracing, and bridging in accordance with manufacturer's instructions.
2. Locate joist end bearing directly over load-bearing stud or provide load distribution member at top of stud track. See Design Drawings.
3. Provide an additional joist under parallel, non-load bearing partitions that run more than 1/3 the span of the joist.
4. Join members forming trusses by welding.
5. Provide web stiffeners at continuous studs over supports.

3.2 tolerances

- A. Maximum Variation from True Position: 1/4 inch.

B. Maximum Variation of any Member from Plane: 1/4 inch.

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Steel shapes for supporting elevator components, including:
  - a. Sill supports
  - b. Hoist beams
  - c. Elevator pit sump covers.
  - d. Elevator pit ladder
5. Slotted channel framing.
6. Roof opening framing not otherwise detailed.
7. Metal ladders.
8. Metal downspout boots.
9. Equipment screen supports.

## B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

## C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.

## 1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Metal downspout boots.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for operable partitions.
  2. Steel framing and supports for overhead doors.
  3. Steel framing and supports for mechanical and electrical equipment.
  4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  5. Elevator machine beams, hoist beams,.
  6. Steel shapes for supporting elevator components, including:
    - a. Sill supports.
    - b. Hoist beams.
    - c. Elevator pit sump covers.
    - d. Elevator pit ladder.
  7. Shelf angles.
  8. Loose steel lintels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.
- D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches, unless larger size required by manufacturer's written recommendation for supported item and span.
  - 2. Material: Cold-rolled steel, ASTM A1008/A1008M, commercial steel, Type B; 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  - 1. Provide stainless steel fasteners for fastening aluminum and stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: For items scheduled to receive high performance coating: Provide primers that comply with Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: For interior items not indicated to receive paint: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
  1. Product: ZRC Worldwide, [ZRC Zero-VOC Galvanizing Repair Compound](#).
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
  1. Product: [CRL Bituminous Coating](#).
- F. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, non-staining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

#### 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, 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.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 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.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch 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.
- E. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

## 2.7 METAL LADDERS

## A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

## B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-square, steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallicly bonded to rung.
7. Source Limitations: Obtain nonslip surfaces from single source from single manufacturer.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Prime ladders, including brackets and fasteners, with zinc-rich primer.

## C. Aluminum Ladders:

1. Basis of Design: Subject to compliance with requirements, provide Alaco 561-E Elevator Pit Access ladder or comparable products by one of the following:
  - a. Alaco Ladder Co.
  - b. Fixfast USA.
  - c. O'Keeffe's Inc.
  - d. Precision Ladders, LLC.
2. Source Limitations: Obtain aluminum ladders from single source from single manufacturer.
3. Space siderails 18 inches apart unless otherwise indicated.
4. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4-inch-wide, and 1/8 inch thick.
5. Rungs: Extruded-aluminum tubes, not less than 3/4-inch-deep and not less than 1/8 inch thick, with ribbed tread surfaces.
6. Fit rungs in centerline of siderails; fasten by welding or with stainless steel fasteners or brackets and aluminum rivets.
7. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.

## 2.8 ELEVATOR PIT SUMP COVERS

## A. Fabricate from 3/16-inch abrasive-surface floor plate with four 1-inch-diameter holes for water drainage and for lifting.

## B. Provide steel angle supports unless otherwise indicated.

- a. American Safety Tread Co., Inc.



- b. Wooster Products Inc.
    - 2. Nosings: Grooved units, 3incheswide, for casting into concrete.
    - 3. Application: At exterior cast-in-place concrete steps.
  - C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
  - D. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
    - 1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.
  - E. Apply bituminous paint to concealed surfaces of cast-metal units.
  - F. Apply clear lacquer to concealed surfaces of extruded units.
- 2.9 METAL DOWNSPOUT BOOTS
- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - 1. J.R. Hoe & Sons Inc.
    - 2. Neenah Foundry Company.
  - B. Source Limitations: Obtain downspout boots from single source from single manufacturer.
  - C. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
    - 1. Outlet: Select model to coordinate with site storm drainage piping indicated.
  - D. Prime cast-iron downspout boots with primer specified in Section 099600 "High-Performance Coatings."
- 2.10 GENERAL FINISH REQUIREMENTS
- A. Finish metal fabrications after assembly.
  - B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
- 2.11 STEEL AND IRON FINISHES
- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
    - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer unless indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.12 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLATION OF 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.
- B. Anchor supports for operable partitions and overhead doors securely to, and rigidly brace from, building structure.

### 3.3 REPAIRS

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION

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## SECTION 055213 – PIPE AND TUBE RAILINGS, INTERIOR

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Interior steel pipe and tube railings, shop primed for field applied high performance coating.

## 1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

## 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for 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.
- C. 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.

## 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.5 ACTION SUBMITTALS

## A. Product Data: For the following:

1. Manufacturer's product lines of **mechanically connected** railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

## C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
  - a. Show method of connecting and finishing members at intersections.

- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.

#### 1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - **Stainless Steel**."

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

#### 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Working Stresses: 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.
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

## 2.2 METALS

- A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
  - 1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.3 STEEL

- A. Tubing: ASTM A500 (cold formed) or ASTM A513.
- B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5 for zinc coating.
  - 2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- 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. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.6 FABRICATION

- A. 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. Shop assemble railings 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. Make handrails smooth to the touch.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed 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. As detailed.
- J. For changes in direction made by bending, use 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.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. 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 metal plate forming bottom closure.

## 2.7 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 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.
  - 1. Shop prime uncoated railings with unless primers specified in Section 099600 "High-Performance Coatings" are indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 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. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. 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. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
  - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- 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.

### 3.3 RAILING CONNECTIONS

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

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends unless otherwise indicated on Drawings.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 ADJUSTING AND CLEANING

- A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

3.7 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.

END OF SECTION

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## SECTION 057100 - DECORATIVE METAL STAIRS

### PART 1 - GENERAL

#### 1.1 SUMMARY

Section includes decorative metal stairs.

Related Requirements:

1. Section 057300 "Decorative Metal Railings, Interior" for custom detailed railings for decorative metal stairs.

#### 1.2 COORDINATION

Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

Coordinate installation of anchorages for metal stairs.

1. 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.
2. Deliver such items to Project site in time for installation.

#### 1.3 ACTION SUBMITTALS

Product Data: For metal stairs and the following:

1. Shop primer products.
2. Precast terrazzo treads.
3. Grout.

Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

Shop Drawings:

4. Include plans, elevations, sections, details, and attachments to other work.
5. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
6. Include plan at each level.

Samples for Selection: For precast treads, showing range of available finishes.

Samples for Verification: For each type and finish of tread.

Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that the engineer is licensed in the jurisdiction in which Project is located.

#### 1.5 QUALITY ASSURANCE

Installer Qualifications: Fabricator of products.

Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

Store materials to permit easy access for inspection and identification.

1. Keep members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
  - a. Repair or replace damaged materials or structures as directed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, [ and railings,] including attachment to building construction.

Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to [**L/360**] [**L/720**] or 1/4 inch, whichever is less.

Component Importance Factor: 1.0.

Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

6. Responsible Sourcing: Recycled content.
7. Responsible Sourcing: Regionally sourced.

8. Responsible Sourcing: Recyclable Content.
9. Responsible Sourcing: Bio-Based Materials.

## 2.2 METALS

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

**Steel Plates, Shapes, and Bars:** ASTM A36/A36M.

**Steel Tubing:** ASTM A500/A500M (cold formed) or ASTM A513/A513M.

**Uncoated, Cold-Rolled Steel Sheet:** ASTM A1008/A1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.

**Uncoated, Hot-Rolled Steel Sheet:** ASTM A1011/A1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

A. **Perforated Metal Risers:** Cold-Rolled Steel Sheet: ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch thick, with 5/16-inch holes on 3/8 inch o.c. in staggered rows.

1. Basis of Design: McNichols item 1651381641.

## 2.3 FASTENERS

**General:** Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

**Bolts and Nuts:** Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

**Anchor Bolts:** ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

**Post-Installed Anchors:** Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

2. **Material for Interior Locations:** Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

## 2.4 MISCELLANEOUS MATERIALS

**Welding Electrodes:** Comply with AWS requirements.

**Shop Primers:** Provide primers that comply with Section 099600 "High-Performance Coatings."

Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for [**interior**] [**exterior**] use; noncorrosive and non-staining; mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 PRECAST TERRAZZO TREADS

Precast Terrazzo Stair Treads: Epoxy terrazzo units cast in maximum lengths possible. Comply with manufacturer's written instructions for fabricating precast terrazzo units in sizes and profiles indicated.

1. **Manufacturers:** Subject to compliance with requirements, provide products by the following:
  - a. **Wausau Tile Inc.**
2. Epoxy Resin Matrix: Manufacturer's standard, recommended for use indicated.
3. Aggregates: Comply with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
  - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M.
  - b. 24-Hour Absorption Rate: Less than 0.75 percent.
  - c. Dust Content: Less than 1.0 percent by weight.
4. Reinforcement: ASTM A615/A615M, Grade 60 bars, as required by unit size, profile, and thickness.
5. Abrasive Inserts: 1/2-inch-wide, alundum oxide/epoxy mixture.
  - a. Provide three inserts, 1/2 inch apart, with first insert located 1 inch from nosing at adjacent stair riser locations.
6. Color: [As selected from manufacturer's standard color selections.] [Coordinate finish selection with Section 096623 "Resinous Matrix Terrazzo Flooring."]
7. Finish: Honed.
8. Surface Sealer: Slip and stain-resistant, penetrating sealer that is chemically neutral with pH factor between 7 and 12; does not affect color or physical properties of terrazzo type indicated; is recommend by sealer manufacturer for use with specified terrazzo; and complies with NTMA guide specification for terrazzo type applicable for this Project.

## 2.6 ABRASIVE NOSINGS

Cast-Metal Units: UL 1994, extruded aluminum, with inserted abrasive treads, with photoluminescent leading edge of contrasting color. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Balco, Inc; IllumiTread Stair Nosing R-315P-PL-100](#), or a comparable product by one of the following:
  - a. **American Safety Tread Co., Inc.**
  - b. **Wooster Products Inc.**



2. Nosings: 3 inches wide, concrete embedded nosing with 1-inch wide photoluminescent insert, 3 abrasive treads, and strap anchors at approximately 12 inches.
3. Application: Cast in place at concrete treads.

Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

## 2.7 FABRICATION, GENERAL

Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

Assemble stairs in shop to greatest extent possible.

3. Disassemble units only as necessary for shipping and handling limitations.
4. Clearly mark units for reassembly and coordinated installation.

Cut, drill, and punch metals cleanly and accurately.

5. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
6. Remove sharp or rough areas on exposed surfaces.

Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

Form exposed work with accurate angles and surfaces and straight edges.

Weld connections to comply with the following:

7. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
8. Obtain fusion without undercut or overlap.
9. Remove welding flux immediately.
10. Weld exposed corners and seams continuously unless otherwise indicated.
11. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #1 - No evidence of a welded joint.

Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

12. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
13. Locate joints where least conspicuous.

## 2.8 FABRICATION OF STAIRS

NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Architectural Class, unless more stringent requirements are indicated.

### Stair Framing:

1. Fabricate stringers of as indicated on Drawings.
  - a. Stringer Size: As indicated on Drawings.
  - b. Provide closures for exposed ends of channel or tube stringers.
  - c. Finish: Shop primed.
2. Construct platforms of steel headers and miscellaneous framing members as indicated on Drawings.
  - a. Provide closures for exposed ends of channel or tube framing.
  - b. Finish: Shop primed.
3. Weld stringers to headers; weld framing members to stringers and headers.

### Subtreads, Risers, and Subplatforms:

4. Fabricate subtreads and subplatforms of steel shapes indicated on Drawings.
5. Form subtreads, risers, and subplatforms to configurations indicated from uncoated, hot-rolled steel sheet of thickness needed to comply with performance requirements, but not less than 0.075 inch thick.
6. Weld subtreads to stringers.
  - a. Locate welds on top of subtreads where they will be concealed by finished treads.
7. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads.
  - a. Weld subplatforms to platform framing.
  - b. Locate welds on top of subplatforms where they will be concealed by finished flooring.

## 2.9 STAIR RAILINGS

Comply with applicable requirements in Section 057300 "Decorative Metal Railings."

1. Connect posts to stair framing by direct welding unless otherwise indicated.

## 2.10 FINISHES

Finish metal stairs after assembly.

### Steel Shop Prime Finish:

1. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedment's for compliance with requirements.

Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLING METAL STAIRS

**Fastening to In-Place Construction:** Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

**Cutting, Fitting, and Placement:** Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

Fit exposed connections accurately together to form hairline joints.

2. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
3. 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.
4. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete." Set abrasive nosings in place, centered on tread.

Install precast terrazzo treads according to manufacturer's written instructions.

#### 3.3 REPAIRS

**Touchup Painting:** Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

END OF SECTION

## SECTION 057300 – DECORATIVE METAL RAILINGS, INTERIOR

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Interior steel decorative railings to match existing stairs, shop primed for field applied high performance coating.
2. Wood cap for metal railing to match existing.

## B. Related Requirements:

1. Section 055213 "Pipe and Tube Railings, Interior " for interior steel pipe and tube railings.

## 1.2 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. 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 items to Project site in time for installation.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

## A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

## B. Shop Drawings: Include plans, elevations, sections, and attachment details.

## C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.

## D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.6 FIELD 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.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Working Stresses: 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.
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

## 2.2 METALS

- A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
  - 1. Provide metal brackets as indicated on Drawings.

## 2.3 STEEL AND IRON DECORATIVE RAILINGS

- A. Manufacturers: Subject to compliance with requirements, provide railings by one of the following:

1. C.R. Laurence Co., CRH Americas Inc.
2. Julius Blum & Co., Inc.
3. Wagner Companies, R&B Wagner.

- B. Tubing: ASTM A500/A500M (cold formed) or ASTM A513.
- C. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A36/A36M.

#### 2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
  2. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Fasteners for Anchoring 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. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

#### 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

#### 2.6 FABRICATION

- A. 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. Make handrails smooth to the touch.
- 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. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.
- I. Form changes in direction as follows:
  - 1. As detailed.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. 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.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.



- 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 metal plate forming bottom closure.

## 2.7 FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. 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.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.8 STEEL AND IRON FINISHES

- A. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, but galvanize anchors to be embedded in exterior concrete or masonry.
- B. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Primer Application: 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 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 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. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. 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. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
- 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.

### 3.3 RAILING CONNECTIONS

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

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  1. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with sleeves concealed within railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach handrails to walls with wall brackets except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
  2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
  1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

### 3.7 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

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## SECTION 057313 - GLAZED DECORATIVE METAL RAILINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Post-supported railings with glass infill.

## 1.2 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

## 1.3 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. 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 items to Project site in time for installation.

## 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.5 ACTION SUBMITTALS

## A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

- C. Samples for Initial Selection: For products involving selection of color, texture, or design.

- D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Each type of glass required.
3. Fittings and brackets.
4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

- E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.

#### 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockups as shown on Drawings.
  - 2. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components that are full height and are not less than 24 inches in length.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 FIELD 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.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Stainless Steel: 60 percent of minimum yield strength.
  - 2. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."
- C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:

- a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
  - b. Infill load and other loads need not be assumed to act concurrently.
3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

## 2.2 GLAZED DECORATIVE METAL RAILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. C.R. Laurence Co., Inc.; CRH Americas, Inc.
  2. Julius Blum & Co., Inc.
  3. VIVA Railings, LLC.
  4. Wagner Companies (The); R&B Wagner, Inc.
- B. Source Limitations for Laminated Glass: Obtain from single source from single manufacturer.
- C. Source Limitations for Decorative Metal Railing Components: Obtain from single source from single manufacturer for each component and installation method.
- D. Product Options: Information on Drawings and in the Specifications establishes requirements for railing system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 2.3 METALS

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

## 2.4 STAINLESS STEEL

- A. Tubing: ASTM A554, Grade MT 304.
- B. Pipe: ASTM A312/A312M, Grade TP 304.
- C. Castings: ASTM A743/A743M, Grade CF 8 or CF 20.
- D. Sheet, Strip, Plate, and Flat Bar: ASTM A666 or ASTM A240/A240M, Type 304.
- E. Bars and Shapes: ASTM A276, Type 304.

## 2.5 GLASS AND GLAZING MATERIALS

- A. Safety Glazing: Glazing shall comply with 16 CFR 1201, Category II.
- B. Laminated Glass: ASTM C1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch thick.
  - 1. Kind: LT (laminated tempered).
  - 2. Glass Color: Clear.
  - 3. Interlayer Color: Clear.
  - 4. Glass Plies for Glass Infill Panels: Thickness required by structural loads, but not less than 5.0 mm each.
- C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- D. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

## 2.6 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Stainless Steel Components: Type 304 stainless steel fasteners.
- B. Fasteners for Anchoring 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. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable.
  - 1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

## 2.7 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.



- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

## 2.8 FABRICATION

- A. 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. Make handrails smooth to the touch.
- 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. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Form changes in direction as follows:
  - 1. As detailed.
- H. Close exposed ends of hollow railing members with prefabricated end fittings.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- J. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- K. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.9 GLAZING PANEL FABRICATION

- A. Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Infill Panels: Provide laminated, tempered glass panels.

#### 2.10 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

#### 2.11 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### 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. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  3. 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. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

- 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 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For stainless steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

### 3.3 INSTALLING GLASS PANELS

- A. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

### 3.4 CLEANING

- A. Clean stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.
- B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

### 3.5 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

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Wood sleepers.
4. Plywood backing panels.
5. Engineered Wood Products

## B. Related Requirements:

1. Section 061600 "Sheathing" for exterior sheathing.

## 1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

## 1.3 ACTION 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 fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
  - a. Laboratory Test Reports: For interior adhesives, sealants, paints, and coatings applied on site, indicating compliance with requirements for low-emitting materials.

## 1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.

3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. 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. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

#### 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2.
  1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
  2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- 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, and the following:
  1. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

### 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  1. Treatment shall not promote corrosion of metal fasteners.
  2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
  3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
  4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664, and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat miscellaneous carpentry located within fire-resistance rated assemblies.

### 2.4 DIMENSION LUMBER FRAMING

- A. Other Framing: No. 2 grade of any species.

### 2.5 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. Cants.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

- C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:
1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
  2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
  3. Eastern softwoods, No. 2 Common grade; NELMA.
  4. Northern species, No. 2 Common grade; NLGA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. 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.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.7 ENGINEERED WOOD PRODUCTS

- A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
1. Available Manufacturers: Manufacturers offering products that may be incorporated into the Project include, but are not limited to, the following:
    - a. Boise Cascade; Versa-Lam.
    - b. Louisiana-Pacific Corporation.
    - c. Weyerhaeuser Company.
  2. Modulus of Elasticity, edgewise: 2,000,000 psi.
  3. Horizontal Shear: 285 psi.
  4. Tension Parallel to Grain: 1950 psi.
- C. Moisture Protection:
1. For southern and eastern species (southern yellow pine, yellow poplar), factory seal laminated veneer lumber on face, edge, and ends.

## 2.8 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 A153/A153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954 as applicable, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
  - 2. Material: For exterior and wet areas: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

## 2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
  - 1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.



- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
  - E. Do not splice structural members between supports unless otherwise indicated.
  - F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
    - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
  - G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
    - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
    - 2. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
    - 3. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
  - H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
  - I. Comply with AWWPA 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.
    - 2. Use copper naphthenate for items not continuously protected from liquid water.
  - J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
  - K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
    - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
    - 2. ICC-ES evaluation report for fastener.
  - L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- 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.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

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## SECTION 061600 - SHEATHING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Wall sheathing.
  - 2. Parapet sheathing.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

## 2.2 WALL SHEATHING

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
  - 1. Type and Thickness: Regular, 1/2 inch thick.

## 2.3 WALL SHEATHING, INTERIOR

- A. Plywood Sheathing: Interior sheathing.
  - 1. Nominal Thickness: 5/8 inch.
  - 2. Application: Under gypsum board finish where indicated for blocking requirements.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

- D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.
- E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
  - 1. For steel framing less than 0.0329-inch-thick, use screws that comply with ASTM C1002.
  - 2. For steel framing from 0.033 to 0.112-inch-thick, use screws that comply with ASTM C954.

## 2.5 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- D. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

- C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.
  - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

END OF SECTION

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## SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Interior standing and running trim.
2. Display Case.
3. Wood cap for interior decorative metal stair railing.
4. Shop priming of interior architectural woodwork.

#### 1.2 COORDINATION

- ##### A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

#### 1.3 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

##### A. Product Data: For the following:

1. Anchors.
2. Adhesives.
3. Shop finishing materials.

- ##### B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

##### C. Shop Drawings:

1. Include the following:
  - a. Dimensioned plans, elevations, and sections.
  - b. Attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Apply AWI Quality Certification Program label to Shop Drawings.

##### D. Samples for Verification: For the following:

1. Standing and running trim: Each unique size and profile, minimum 12 inches long.



## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For architectural woodwork manufacturer and Installer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Architectural Woodwork Standards, Section 2.
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.
- B. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

## PART 2 - PRODUCTS

## 2.1 ARCHITECTURAL WOODWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- B. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  - 1. Low-Emitting Materials: Adhesives and Sealants.
  - 2. Low-Emitting Materials: Field Paints and Coatings.
  - 3. Low-Emitting Materials: Composite Wood or Agrifiber Products.

## 2.2 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- A. Architectural Woodwork Standards Grade: Custom.
- B. Hardwood Lumber:

1. Species: As scheduled.
2. Cut: Plain sliced/plain sawn.
3. Wood Moisture Content: 5 to 10 percent.
4. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.
5. For base wider than available lumber, glue for width. Do not use veneered construction.

## 2.3 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

### A. Architectural Woodwork Standards Grade: Custom.

1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: 5 to 10 percent.

## 2.4 DISPLAY CASE

- A. Display Case: Custom fabricated display case; with finished interior, concealed illumination, sliding glazed doors at front, glass shelves, and plastic laminate face.
- B. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 0641 – Architectural Wood Casework Standard, which replaces Section 10 of the 2014 edition of Architectural Woodwork Standards, for grades and duty level of cabinets indicated for construction, finishes, installation, and other requirements.
- C. ANSI/AWI 0641 Aesthetic Grade: Premium.
1. Duty Level: 3.
- D. Laminate Cladding for Exposed Surfaces:
1. Vertical Surfaces: Grade VGS.
  2. Pattern Direction: Vertically for fixed panels.
- E. Slides for Sliding Glass Doors: ANSI/BHMA A156.9, B07063; aluminum.
- F. Glass Door Locks: Adjustable Ratchet Lock.
1. Basis of Design: Knappe and Vogt, 962/963.
- G. Tempered Float Glass for Display Case Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 6 mm thick unless otherwise indicated.
- H. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 6 mm thick.
- I. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04102; with shelf brackets, B04112.
- J. Polyester Back Panel: Polyester-fabric-faced tackboard panel.
1. Color: Black.

## 2.5 MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 8 to 13 percent.
- B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  - 2. Particleboard: ANSI A208.1, Grade M-2.
  - 3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.
- C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
  - 1. Basis of Design: Subject to compliance with requirements, provide product indicated on Finish Legend or comparable product from one of the following:
    - a. ABeti Laminati.
    - b. Formica Corporation.
    - c. Panolam Surface Systems.
    - d. Wilsonart.
- D. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- E. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
  - 1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
  - 2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

## 2.6 FABRICATION

- A. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
  - 1. Ease edges to radius indicated for the following:
    - a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
    - b. Edges of Rails and Similar Members More Than 3/4-Inch-Thick: 1/8 inch.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
  - 1. Disassemble components only as necessary for shipment and installation.
  - 2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.
  - a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
  - b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.
- B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

#### 3.2 INSTALLATION

- A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.
- B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.
- C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
  1. Shim as required with concealed shims.
  2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
  1. Secure with countersunk, concealed fasteners and blind nailing.
  2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.
  3. For shop-finished items, use filler matching finish of items being installed.
- F. Standing and Running Trim:
  1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
  2. Do not use pieces less than 60 inches long, except where shorter single-length pieces are necessary.
  3. Scarf running joints and stagger in adjacent and related members.
  4. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.

5. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

### 3.3 REPAIR

- A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.
- B. Where not possible to repair, replace defective woodwork.

### 3.4 CLEANING

- A. Clean interior architectural woodwork on exposed and semi-exposed surfaces.

END OF SECTION

## SECTION 071616 - CRYSTALLINE WATERPROOFING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes crystalline waterproofing for negative-side application to interior of concrete at elevator pit and as indicated on Drawings.
- B. Related Sections:
  - 1. Section 033000 "Cast-in-Place Concrete" for crystalline waterproofing admixture and water stops' and finishing concrete walls and slabs to receive waterproofing.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include material descriptions and installation instructions for crystalline waterproofing.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## 1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

## 1.4 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.
- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
  - 1. Low-Emitting Materials: Field applied interior paints and coatings.

## 2.2 WATERPROOFING MATERIALS

- A. Crystalline Waterproofing: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Anti-Hydro International, Inc; A-H Hydrocap.
    - b. AQUAFIN, Inc; AQUAFIN-1C.
    - c. BASF Corporation; MasterSeal 500.
    - d. Euclid Chemical Company (The); an RPM company; HEY'DI K-11.
    - e. Xypex Chemical Corporation; Xypex Concentrate.
  2. Water Permeability: Maximum zero for water at 30 feet when tested according to CE CRD-C 48.
  3. Compressive Strength: Minimum 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Source Limitation: Provide product compatible with Permeability-Reducing Admixture specified in Section 033000 "Cast-in-Place Concrete."

## 2.3 ACCESSORY MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Sand: ASTM C 144.
- C. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.
1. VOC: 0 g/L.
- D. Water: Potable.

## 2.4 MIXES

- A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.
- B. Protective Topping: Measure, batch, and mix portland cement and sand in the proportion of 1:3 and water gaged with a polymer admixture. Blend together with mechanical mixer to required consistency.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.
- B. Proceed with application only after unsatisfactory conditions have been corrected.
- C. Notify Architect in writing of active leaks or defects that would affect system performance.

## 3.2 PREPARATION

- A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.
- C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.
- D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
  - 1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately 1 inch deep. Fill reveal with patching compound flush with surface.
- E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
  - 1. Clean concrete surfaces according to ASTM D 4258.
    - a. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
  - 2. Clean concrete unit masonry surfaces according to ASTM D 4261.
    - a. Lightweight Concrete Unit Masonry: Etch with 10 percent muriatic (hydrochloric) acid solution or abrade surface by wire brushing. Remove acid residue until pH readings of water after rinse are not more than 1.0 pH lower or 2.0 pH higher than pH of water before rinse.
  - 3. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.



### 3.3 APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
  - 1. Saturate surface with water for several hours prior to application and maintain damp condition until applying waterproofing. Remove standing water.
  - 2. Apply waterproofing to surfaces indicated on Drawings.
    - a. Apply at inside of elevator pit walls up to floor line and to top of pit slab.
  - 3. Number of Coats: Two.
  - 4. Application Method: Brush or Spray. Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
  - 5. Dampen surface between coats.
- B. Final Coat Finish: Brushed or Spray Textured.
- C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.
- D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
  - 1. Onto columns integral with treated walls.
  - 2. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches for cast-in-place concrete and 48 inches for masonry.
  - 3. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches, where floors, but not walls, are treated.
  - 4. Onto every substrate in areas indicated for treatment, including pipe trenches pipe chases pits sumps and similar offsets and features.
- E. Protective Topping: Apply 1-inch-thick, protective topping over floor surfaces.

END OF SECTION

## SECTION 071900 - WATER REPELLENTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes penetrating water-repellent treatments for the following vertical and horizontal surfaces:

1. Clay masonry.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

## 1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

- B. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Locate mockups on masonry sample panels.

- a. Size: 10 sq. ft. each.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.4 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
3. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
4. Rain or snow is not predicted within 24 hours.
5. Not less than 24 hours have passed since surfaces were last wet.
6. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents shall meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.
- B. Water Absorption: Minimum 80 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the following:
  - 1. Precast Concrete: ASTM C 642.
  - 2. Concrete Masonry Units: ASTM C 140.
- C. Water-Vapor Transmission: Comply with one or both of the following:
  - 1. Minimum 80 percent water-vapor transmission of treated compared to untreated specimens, according to ASTM D 1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate of treated compared to untreated specimens, according to ASTM E 514/E 514M.
- E. Durability: Maximum 5 percent loss of water-repellent performance after 2500 hours of weathering according to ASTM G 154 compared to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
  - 1. Reduction of Water Absorption: 80 percent.
  - 2. Reduction in Chloride Content: 80 percent.

## 2.2 PENETRATING WATER REPELLENTS

- A. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 100 g/L or less of VOCs. SWRI validated.
  - 1. Available Products: Available products include, but are not limited to, the following:
    - a. Pecora Corporation; KlereSeal 910-W.
    - b. PROSOCO, Inc; Siloxane WB Concentrate.
    - c. Sika Corporation; Sikagard 701W.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
  - 1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.

2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
  3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
1. Test substrate prior to general application in presence of manufacturer's representative.
- D. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- E. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- F. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

### 3.3 APPLICATION

- A. Apply coating of water repellent on surfaces to be treated using 15 psi-pressure spray with a fan-type spray nozzle to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
1. Precast Concrete and Cast Stone: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.
- B. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces

between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

### 3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

## SECTION 072100 - THERMAL INSULATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass-fiber blanket.
  - 2. Detailing foam insulation.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  - 1. **Low-Emitting Materials: Thermal and Acoustic Insulation.**

## 2.2 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
  - 1. Application: Cavities in framed sheathed walls and where indicated on Drawings.

## 2.3 DETAILING FOAM INSULATION

- A. Low-Expansion Detailing Foam: Single-component urethane foam with low-expansion pressure, and 10 percent flexibility, suitable for installation adjacent to fenestration. Provide product complying with AAMA 812.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical; Great Stuff Pro Window & Door.
    - b. Zerodraft Products, Inc.; Zero Draft Foam Sealant.
    - c. Hilti; Window & Door Pro Foam.

## 2.4 ACCESSORIES

### A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 3.3 INSTALLATION OF CAVITY-WALL INSULATION

- A. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches from each corner of board insulation, at center of board, and as recommended by manufacturer.
  1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
  2. Press units firmly against inside substrates.

### 3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically.

- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
  - 2. Low-Expansion Detailing Foam: Apply according to manufacturer's written instructions.

### 3.5 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION



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## SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vapor-permeable, fluid-applied air barriers.

#### 1.2 DEFINITIONS

- A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.
- B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.
- C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- B. Protect stored materials from direct sunlight.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
  - 1. Protect substrates from environmental conditions that affect air-barrier performance.
  - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing where applicable, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

## 2.3 LOW-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. Low-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils over smooth, void-free substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Corporation; MasterSeal AWB 660.
    - b. Pecora Corporation; Pecora XL-Perm.
    - c. Polyguard Products, Inc.; Polyguard Airluk Flex VP.
    - d. PROSOCO, Inc; R-Guard Cat 5.
    - e. Sto Corp; Sto EmeraldCoat®.

- f. W.R. Meadows, Inc; Air-Shield TMP.

## 2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187-inch-thick, and Series 300 stainless-steel fasteners.
- D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
  4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.
- H. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.3 ACCESSORIES INSTALLATION

- A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip or preformed silicone extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  - 1. Transition Strip: Roll firmly to enhance adhesion.
  - 2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

### 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 2. Limit priming to areas that will be covered by air-barrier material on same day. Re-prime areas exposed for more than 24 hours.
  - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Low-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
  - 1. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements but not less than 10 mils, applied in one or more equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.5 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
  - 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
  - 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

## SECTION 074215 - METAL COMPOSITE MATERIAL WALL PANELS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes metal composite material wall panels.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

- B. Shop Drawings:

- 1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

- 1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

- 1. Water-Spray Test: Conduct water-spray test of mockup of metal composite material panel assembly, testing for water penetration according to AAMA 501.2.



2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.
- B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal composite material panels during installation.

#### 1.8 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

#### 1.9 COORDINATION

- A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, 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 composite material panel systems 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 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 composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 METAL COMPOSITE MATERIAL WALL PANELS

- A. Standard Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ALPOLIC Materials; Mitsubishi Chemical Composites.
    - b. ALUCOBOND; 3A Composites USA, Inc.
    - c. Arconic.
- B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.
1. Panel Thickness: 0.157 inch (4 mm).
  2. Core: Fire retardant.
  3. Exterior Finish: Two-coat mica fluoropolymer.
    - a. Color: As indicated by selection on Drawings.
- C. Perforated Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.
1. Panel Thickness: 0.157 inch (4 mm).
  2. Core: Fire retardant.
  3. Exterior Finish, both sides: Two-coat fluoropolymer.
  4. Perforations: Maximum 45 percent free area.
- D. Attachment Assembly Components: Formed from extruded aluminum.
- E. Attachment Assembly: Clip.

### 2.2 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as needed for support and alignment of metal composite material panel system.

- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal composite material panels and remain weathertight; and as recommended in writing by metal composite material panel manufacturer.

### 2.3 FABRICATION

- A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and 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 in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

## 2.4 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Aluminum Panels and Accessories:
  - 1. PVDF Fluoropolymer: AAMA 2605, two-coat, with suspended mica flakes, fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
  - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal composite material panel manufacturer's written recommendations.

### 3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

- A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports

unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
  2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
  3. Install screw fasteners in predrilled holes.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.
  5. Install flashing and trim as metal composite material panel work proceeds.
  6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.
- D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.
1. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
- F. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-turned flanges of wall panels to panel clips with manufacturer's standard fasteners.
1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 079200 "Joint Sealants."
  2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.
- G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.
- H. 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 are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### 3.4 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing agency to perform field tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.
- C. Metal composite material wall panels will be considered defective if they do not pass test and inspections.
- D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- E. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

## SECTION 074646 - FIBER-CEMENT SOFFIT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fiber-cement soffit.

#### 1.2 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples for Verification: For each type, color, texture, and pattern required.
  - 1. 12-inch-long-by-actual-width Sample of soffit.
  - 2. 12-inch-long-by-actual-width Samples of trim and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.



2. Warranty Period: 25 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

### 2.2 FIBER-CEMENT SOFFIT

- A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Basis-of-Design Product: Subject to compliance with requirements, provide listed products of James Hardie Building Products, Inc., or comparable products by one of the following:

- a. CertainTeed Corporation.
- b. Nichiha Fiber Cement.
- c. Swiss Pearl.

- B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

- C. Fiber-Cement Siding: Soffit Panel:

1. Texture: Smooth.
2. Thickness: 5/16 inch.
3. Application: Unperforated.
4. Finish: Factory primed and first coat color. Field paint final coat: Match Architect's custom color.
5. Product: [HardiPanel Unvented, Smooth](#).

- D. Fiber-Cement Trim:

1. Texture: Smooth.
2. Thickness: 5/4 thickness at window openings.
3. Finish: Factory primed and first coat color. Field paint final coat: Match Architect's custom color.
4. Product: [HardiTrim, Smooth](#).

### 2.3 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Corner posts.
  2. Door and window casings.
  3. Fasciae.
  4. Moldings and trim.
- C. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
1. Finish for Aluminum Flashing: Factory-prime coating.
- D. Trims: [Fry Reglet Fiber Cement Panel Trims](#) or [Tamlyn, XtremeTrim](#). Include the following:
1. Horizontal panel to panel joints.
  2. Horizontal soffit to panel joint.
- E. Fasteners:
1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
  2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
  3. For fastening fiber cement, use hot-dip galvanized fasteners.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement soffit and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

#### 3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  1. Do not install damaged components.
  2. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

#### 3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

## SECTION 075216 - SBS MODIFIED BITUMINOUS MEMBRANE ROOFING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Styrene-butadiene-styrene (SBS)-modified bituminous membrane roofing.
2. Roof insulation.
3. Cover board.
4. Walkways.

## B. Section includes the installation of sound-absorbing insulation strips in ribs of roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

## C. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal flashings and counterflashings, manufactured reglets, and counterflashings.
3. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

## 1.2 DEFINITIONS

## A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

## 1.3 PREINSTALLATION MEETINGS

## A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier 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, specifications, drawing details, and referenced details.
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 affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:
  - 1. Layout and thickness of insulation.
  - 2. Base flashings and membrane terminations.
  - 3. Flashing details at penetrations.
  - 4. Tapered insulation, including slopes.
  - 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
  - 6. Crickets, saddles, and tapered edge strips, including slopes.
  - 7. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  - 8. Tie-in with adjoining air barrier.
- C. Samples for Verification: For the following products:
  - 1. Cap Sheet: Samples of specified color.
  - 2. Flashing Sheet: Samples of specified color if different than cap sheet.
  - 3. Walkway Pads or Rolls: Samples of specified color.
- D. Wind Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Contractor's Product Certificate: Submit notarized certificate, indicating products intended for Work of this Section, including product names and numbers and manufacturers' names, with statement indicating that products to be provided meet the requirements of the Contract Documents.
- C. Manufacturer Certificates:
  - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
    - a. Submit evidence of complying with performance requirements.
  - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- D. Field quality-control reports.
- E. Sample Warranties: For manufacturer's special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing system to include in maintenance manuals.
- B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified listed manufacturer that is UL listed for roofing system identical to that used for this Project.
- B. Installer Qualifications: An employer of workers trained and certified by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing products comparable to those specified, able to communicate verbally with Contractor, Architect, and employees, and qualified by the roofing system manufacturer to install manufacturer's product and furnish warranty of type specified.
- C. Roofing Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified roofing system, qualified to perform roofing observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Roofing Inspector shall be one of the following:
  - 1. An authorized full-time technical employee of the manufacturer.
  - 2. An independent party certified as a Registered Roof Observer by the Roof Consultants Institute, retained by the Contractor or the Manufacturer and approved by the Manufacturer.

## 1.8 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, approval or listing agency markings, 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 roofing system manufacturer.
  - 1. Protect stored liquid material from direct sunlight.
  - 2. 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.
  - 1. Store in a dry location.
  - 2. 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.

## 1.9 FIELD 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.
- B. Daily Protection: Coordinate installation of roofing so insulation and other components of roofing 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 and insulation with a course of roofing sheet securely in place with joints and edges sealed.
  - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
  - 3. Remove temporary plugs from roof drains at end of each day.
  - 4. Remove and discard temporary seals before beginning work on adjoining roofing.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, 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 the Work of this Section, including all components of roofing system such as roof 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 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.
  - 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
  - 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.
- B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

- C. Wind Uplift Resistance: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency in accordance with ANSI/FM 4474, UL 580, or UL 1897, and to resist uplift pressures calculated in accordance with ASCE-7 and applicable code.
  - 1. All Zones (Corner, Perimeter, and Field-of-Roof) Uplift Pressures: As indicated on Contractor's approved shop drawings based upon Project design wind speed indicated on Drawings.
- D. Flashings: Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations of the following:
  - 1. FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings.
  - 2. FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components.
  - 3. NRCA Roofing Manual (Sixth Edition) for construction details and recommendations.
  - 4. SMACNA Architectural Sheet Metal Manual (Seventh Edition) for construction details.
- E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide membrane roofing products by one of the following:
  - 1. Holcim Elevate (Firestone Building Products).
  - 2. GAF.
  - 3. Siplast.
  - 4. Soprema.
- B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturer approved by roof membrane manufacturer.

- C. Torch-Applied Systems: Not permitted.

## 2.3 SBS MODIFIED BITUMINOUS BASE PLY SHEET

- A. SBS-Modified Bitumen Fiberglass Mat Base Ply Sheet: ASTM D6163/D6163M, Type II, Grade S, SBS-modified asphalt sheet, reinforced with fiberglass fabric, smooth surfaced, suitable for cold adhesive application method.

## 2.4 SBS MODIFIED BITUMINOUS CAP SHEET

- A. Granule-Surfaced Roofing Cap Sheet: ASTM D6162/D6162M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with a combination of polyester and fiberglass fabric, suitable for cold adhesive application method.
  - 1. Granule Color: White.



## 2.5 BASE FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D4601/D4601M, Type I, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides, or use product specified for base ply sheet.
- B. Granule-Surfaced Flashing Sheet: ASTM D6164/D6164M, Type II, Grade G, SBS-modified asphalt sheet, reinforced with polyester fabric, granule surfaced, suitable for application method specified, and as follows:
  - 1. Granule Color: Match cap sheet.

## 2.6 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
- B. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.
- C. Cold-Applied Polymer-Modified Asphalt Adhesive: Roof membrane manufacturer's standard solvent-and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with specified roof membranes.
- D. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required by roofing system manufacturer for application.
- E. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, non-skinning, and nondrying.
- F. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.
- G. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

## 2.7 ROOF INSULATION

- A. General: Preformed roof insulation boards manufactured or approved by PVC roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.
- B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, glass-fiber mat facer on both major surfaces.
  - 1. Compressive Strength: 20 psi.
- C. Tapered Insulation: Provide factory-tapered insulation boards.
  - 1. Material: Match roof insulation.
  - 2. Minimum Thickness: 1/4 inch.
  - 3. Slope:

- a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
- b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

## 2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
  1. Modified asphaltic, asbestos-free, cold-applied adhesive.
  2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
  3. Full-spread spray-applied, low-rise, two-component urethane adhesive.
- D. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
- E. Wood Nailer Strips: Comply with requirements in Section 061053 "Miscellaneous Rough Carpentry."
- F. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.
- G. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
  1. Thickness: 1/2 inch.
  2. Surface Finish: Factory primed or unprimed as recommended by roofing membrane manufacturer for application.

## 2.9 WALKWAYS

- A. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing system manufacturer, 1/2-inch-thick, minimum.
  1. Pad Size: Approximately 36 by 60 inches.
  2. Color: Contrasting with cap sheet.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
  1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.

2. Verify that wood cants, blocking, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch out of plane relative to adjoining deck.

B. 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.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

### 3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roof membrane and auxiliary materials to tie into existing roofing to maintain weathertightness of transition.

D. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified in Section 072726 "Fluid-Applied Membrane Air Barriers."

E. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

F. Installation Details: Install roofing system in accordance with applicable NRCA Manual Plates and NRCA recommendations; modify as required to comply with manufacturer's approved details and perimeter fastening requirements of FM Global references if applicable.

G. Install roofing system in accordance with the following NRCA Manual Plates and NRCA recommendations; modify as required to comply with requirements of FMG references above:

1. Metal Parapet Cap (Coping) and Base Flashing: Plates MB-1 and MB-1S.
2. Surface-Mounted Counterflashing for Concrete Walls (at Parapet Wall): Plates MB-4 and MB-4S.
3. Base Flashing for Wall-supported Deck: Plates MB-5 and MB-5S.

4. Base Flashing for Non-wall-supported deck (Movement Joint): Plates MB-6 and MB-6S.
5. Base and Surface-mounted Counterflashing: Plates MB-4 and MB-4S.
6. Raised Perimeter Edge with Metal Flashing (Fascia Cap): Plates MB-2 and MB-2S.
7. Embedded Edge Metal Flashing Edge (Gravel-stop): Plates MB-3 and MB-3S.
8. Scupper Through Raised Perimeter Edge: Plates MB-21 and MB-21S.
9. Gutter at Draining Edge: Plates MB-22 and MB-22S.
10. Expansion Joint with Metal Cover: Plates MB-7 and MB-7S and Division 07 Section "Sheet Metal Flashing and Trim."
11. Expansion Joint with Premanufactured Cover: Plates MB-7A and MB-7AS and Division 07 Section "Roof Expansion Assemblies."
12. Area Divider in Roof System: Plates MB-8 and MB-8S.
13. Equipment Support Stand and Typical Rain Collar Penetration Detail: Plates MB-11 and MB-11S.
14. Raised Curb Detail at Rooftop HVAC Units, Premanufactured: Plates MB-12 and MB-12S and Division 7 Section "Roof Accessories."
15. Skylight, Scuttle (Roof Hatch), and Smoke Vents: Plates MB-14 and MB-14S and Division 07 Section "Roof Accessories."
16. Penetration, Sheet Metal Enclosure for Piping Through Roof Deck: Plates MB-16 and MB-16S
17. Penetration, Isolated Stack Flashing: Plates MB-17 and MB-17S.
18. Penetration, Isolated Stack Flashing: Plates MB-17A and MB-17AS.
19. Penetration, Plumbing Vent: Plates MB-18 and MB-18S.
20. Penetration, Pocket: Plates MB-19 and MB-19S.
21. Roof Drain: Plates MB-20 and MB-20S.
22. Roof Drain: Plates MB-20A and MB-20AS.
23. Guide for Clearances between Pipes / Walls / Curbs – Table 4
24. Guide for Crickets and Saddles – Table 5
25. Guide for Edge Scuppers with Tapered Saddles - Table 6

### 3.4 INSTALLATION OF INSULATION

- A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Cant Strips: Install and secure cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 deg F.
- D. Installation Over Metal Decking:
  1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
    - a. Locate end joints over crests of decking.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    - d. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.

- 1) Trim insulation, so that water flow is unrestricted.
  - e. Fill gaps exceeding 1/4 inch with insulation.
  - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Where vapor retarder / air barrier sheet is not required, tape joints of base layer of insulation.
  3. Install upper layers of insulation and tapered insulation, with joints of each layer offset not less than 12 inches from previous layer of insulation.
    - a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    - b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
    - c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    - e. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.
    - f. Trim insulation, so that water flow is unrestricted.
    - g. Fill gaps exceeding 1/4 inch with insulation.
    - h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    - i. Adhere each layer of insulation to substrate using adhesive according to manufacturer's written instructions.
  - 1) Adhere insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

### 3.5 INSTALLATION OF COVER BOARDS

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
  1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
    - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

### 3.6 INSTALLATION OF ROOFING MEMBRANE, GENERAL

- A. Install roofing system according to roofing system manufacturer's written instructions and applicable recommendations in ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.
- C. Where roof slope exceeds 1/2 inch per 12 inches, install roofing membrane sheets parallel with slope.
  - 1. Backnail roofing sheets to substrate according to roofing system manufacturer's written instructions.
- D. Coordinate installation of roofing system so insulation and other components of the roofing 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 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.

### 3.7 INSTALLATION OF SBS-MODIFIED BASE PLY SHEET

- A. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature.
- B. Install base ply sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
  - 1. Extend roofing sheets over and terminate above cants.
  - 2. Install base ply sheet in a shingle fashion.
  - 3. Adhere to substrate in a uniform coating of cold-applied adhesive.
    - a. Adhere base ply sheet to resist specified uplift pressure at corners, perimeter, and field of roof.
- C. Install base ply sheet without wrinkles, rears, and free from air pockets.
- D. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
  - 1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.
  - 2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.
  - 3. Stagger end laps not less than 18 inches.
  - 4. Heat weld or completely bond and seal end and side laps, leaving no voids.
  - 5. Roll laps with a 20-pound roller.

- E. Repair tears and voids in laps and lapped seams not completely sealed.
- F. Apply pressure to the body of the base sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

### 3.8 INSTALLATION OF SBS-MODIFIED BITUMINOUS CAP SHEET

- A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by manufacturer for the ambient temperature at which cap sheet will be installed.
- B. Install modified bituminous roofing cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system.
  - 1. Extend cap sheet over and terminate above cants.
  - 2. Install cap sheet in a shingle fashion.
  - 3. Install cap sheet as follows:
    - a. Adhere to substrate in cold-applied adhesive.
  - 4. Install cap sheet without wrinkles or tears, and free from air pockets.
  - 5. Install cap sheet so side and end laps shed water.
- C. Laps: Accurately align roofing sheets, without stretching, and maintain uniform side and end laps.
  - 1. Lap side laps as recommended by roof membrane manufacturer but not less than 3 inches.
  - 2. Lap end laps as recommended by roof membrane manufacturer but not less than 12 inches.
  - 3. Stagger end laps not less than 18 inches.
  - 4. Heat weld laps, leaving no voids.
  - 5. Roll laps with a 20-pound roller.
  - 6. Repair tears and voids in laps and lapped seams not completely sealed.
- D. Apply pressure to the body of the cap sheet according to manufacturer's instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.
- E. Apply roofing granules of same color as roof membrane to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

### 3.9 INSTALLATION OF FLASHING AND STRIPPING

- A. Install base flashing over cant strips and other sloped 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. Prime substrates with asphalt primer if required by roofing system manufacturer.
  - 2. Backer Sheet Application:
    - a. Adhere backer sheet to substrate in cold-applied adhesive.
    - a. Seal all laps.
  - 3. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

- a. Heat weld laps, leaving no voids.
- 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 using continuous termination bar.
- D. Install roofing cap-sheet stripping where metal flanges and edgings are set on roofing according to roofing system manufacturer's written instructions.
- E. Roof Drains: Set 30-by-30-inch-4-pound lead flashing in bed of asphaltic adhesive on completed roofing membrane.
  1. Cover lead flashing with roofing cap-sheet stripping and extend a minimum of 6 inches beyond edge of metal flashing onto field of roofing membrane.
  2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
  3. Install stripping according to roofing system manufacturer's written instructions.

### 3.10 INSTALLATION OF WALKWAYS

- A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.
  1. Install walkways at the following locations:
    - a. Perimeter of each rooftop unit.
    - b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
    - c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
    - d. Top and bottom of each roof access ladder.
    - e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
    - f. Additional locations indicated on Drawings and as required by roof membrane manufacturer's warranty requirements.
  2. Provide 3-inch clearance between adjoining pads.
  3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
  1. Notify Architect and Owner 48 hours in advance of date and time of inspection.



- C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
- D. Roofing system will be considered defective if it does not pass tests and inspections.
  - 1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

### 3.12 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period.
  - 1. When remaining construction does not affect or endanger roofing, inspect roofing system 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.

SECTION CONTINUES

3.13 ROOFING INSTALLER'S WARRANTY

A. WHEREAS \_\_\_\_\_ of \_\_\_\_\_, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: \_\_\_\_\_.
2. Address: \_\_\_\_\_.
3. Building Name/Type: \_\_\_\_\_.
4. Address: \_\_\_\_\_.
5. Area of Work: \_\_\_\_\_.
6. Acceptance Date: \_\_\_\_\_.
7. Warranty Period: \_\_\_\_\_.
8. Expiration 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 Roofing Installer will, at Roofing Installer's 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 74 MPH;
  - c. fire;
  - d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
  - e. faulty construction of parapet walls, copings, chimneys, skylights, vents, 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, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or 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 \_\_\_\_\_ day of \_\_\_\_\_.

- 1. Authorized Signature: \_\_\_\_\_
- 2. Name: \_\_\_\_\_
- 3. Title: \_\_\_\_\_

3.14 END OF SECTION

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed roof-drainage sheet metal fabrications.
3. Formed low-slope roof sheet metal fabrications including roof-edge specialties and formed roof expansion joints.

## B. Related Requirements:

1. Section 077200 "Roof Accessories" for equipment supports, and other manufactured roof accessory units.

## 1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

## 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site in conjunction with roofing conference.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

## 1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.

3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  4. Include details for forming, including profiles, shapes, seams, and dimensions.
  5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  6. Include details of termination points and assemblies.
  7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  8. Include details of roof-penetration flashing.
  9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  10. Include details of special conditions.
  11. Include details of connections to adjoining work.
  12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.
- D. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.
  - B. Qualification Data: For fabricator.
  - C. Sample Warranty: For special warranty.
- 1.6 QUALITY ASSURANCE
- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
    1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
    1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
    2. Protect stored sheet metal flashing and trim from contact with water.
  - B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.8 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
- B. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
  - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
  - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
- C. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on approved roofing shop drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:

- a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. Color: Match Architect's sample.
  3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).
    - a. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
    - b. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
      - 1) Run grain of directional finishes with long dimension of each piece.
      - 2) When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

### 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
1. Source Limitations: Obtain underlayment from single source from single manufacturer.
  2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

### 2.4 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.

- b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
  - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- 3. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2-inch-wide and 1/8 inch thick.
- D. Elastomeric Sealant: When exposed or partially exposed in metal joints: ASTM C920, 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. Butyl Sealant: Where concealed in metal joints: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- G. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.5 REGLETS AND COUNTERFLASHINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Cheney Flashing Company.
  - 2. Fry Reglet Corporation.
  - 3. Heckmann Building Products, Inc.
- B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
  - 1. Formed Aluminum: 0.024 inch thick.
  - 2. Corners: Factory mitered and continuously welded.
  - 3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
  - 4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.
- C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
  - 1. Formed Aluminum: 0.024 inch thick.
- D. Accessories:



1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Aluminum Finish: Mill.

## 2.6 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
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.

H. Do not use graphite pencils to mark metal surfaces.

## 2.7 ROOF-DRAINAGE SHEET METAL FABRICATIONS

### A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock or twisted gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Gutter Profile: As indicated on Drawings.
6. Expansion Joints: Butt type with cover plate.
7. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:

a. Aluminum: 0.040 inch thick.

B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricated Hanger Style: Fig. 1-35A in accordance with SMACNA's "Architectural Sheet Metal Manual."
2. Fabricate from the following materials:

a. Aluminum: 0.040 inch thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:

1. Stainless Steel: 0.0188 inch thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

E. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Stainless Steel: 0.0188 inch thick.

## 2.8 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
  - 1. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
  - 2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  - 3. Fabricate from the following materials:
  - 4. Aluminum: 0.050 inch thick.
- B. Roof and Roof-to-Wall Transition Expansion-Joint Cover: Shop fabricate interior and exterior corners. Fabricate from the following materials:
  - 1. Aluminum: 0.050 inch thick.
- C. Roof-Penetration Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.0188 inch thick.
- D. Roof-Drain Flashing: Fabricate from the following materials:
  - 1. Stainless Steel: 0.0156 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering, High-Temperature Sheet Underlayment:
  - 1. Install self-adhering, high-temperature sheet underlayment, wrinkle free.
  - 2. Prime substrate if recommended by underlayment manufacturer.
  - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
  - 4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.

5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

### 3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
  6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  8. Do not field cut sheet metal flashing and trim by torch.
  9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

### 3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
1. Join sections with joints sealed with sealant.
  2. Provide for thermal expansion.
  3. Attach gutters at eave or fascia to firmly anchor them in position.
  4. Provide end closures and seal watertight with sealant.
  5. Slope to downspouts.
  6. Fasten gutter spacers to front and back of gutter.
  7. Anchor and loosely lock back edge of gutter to continuous cleat.
  8. Anchor gutter with gutter brackets spaced not more than 24 inches apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
  9. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
- C. Downspouts:
1. Join sections with 1-1/2-inch telescoping joints.
  2. Provide hangers with fasteners designed to hold downspouts securely to walls.
  3. Locate hangers at top and bottom and at approximately 60 inches o.c.
  4. Provide elbows at base of downspout to direct water away from building.
  5. Connect downspouts to underground drainage system.
- D. Splash Pans:
1. Install where downspouts discharge on low-slope roofs.
  2. Set in elastomeric sealant compatible with the substrate.
- E. Parapet Scuppers:

1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
  2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
  3. Loosely lock front edge of scupper with conductor head.
  4. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.
- F. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper discharge.
- G. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

### 3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
  2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
  3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.
- C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

### 3.6 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: Rout existing mortar joint; set and wedge reglet into joint and apply silicone joint sealant along top edge of embedded reglet.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### 3.7 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.8 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### 3.9 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in 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, as determined by Architect.

END OF SECTION

## SECTION 077200 - ROOF ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Roof curbs. Refer to Division 23 specifications.
2. Equipment supports. Refer to Division 23 specifications.
3. Roof hatches.
4. Pipe portals.
5. Preformed flashing sleeves.

## B. Related Requirements:

1. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, fasciae, copings, gravel stops, downspouts, and counterflashing roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

## 1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

## B. Delegated-Design Submittal: For equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

## 1.4 CLOSEOUT SUBMITTALS

## A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.



## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: Per design wind speed indicated on Structural Drawings.

## 2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Curbs Plus, Inc.
    - b. Greenheck Fan Corporation.
    - c. LMCurbs.
    - d. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
    - e. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.
- D. Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet, not less than 0.052 inch thick.
  - 1. Finish: Baked enamel or powder coat.
  - 2. Color: White.
- E. Construction:
  - 1. Curb Profile: Manufacturer's standard compatible with roofing system.
  - 2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  - 3. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
  - 4. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
  - 5. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
  - 6. Liner: Same material as curb, of manufacturer's standard thickness and finish.

7. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
8. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
9. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
10. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
11. Security Grille: Provide for all units.
12. Damper Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.

### 2.3 ROOF HATCHES

- A. Roof Hatches: Thermally improved metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Bilco Company (The), Single Leaf Roof Access Hatch E-50TB or a comparable product by one of the following:
    - a. Architectural Specialties, Inc.
    - b. Babcock-Davis.
    - c. Nystrom.
    - d. O'Keeffe's Inc.
    - e. Pate Company (The).
- B. Type and Size: Single-leaf lid, 36 by 36 inches.
- C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- D. Hatch Material: Aluminum sheet.
  1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  2. Finish: Baked enamel or powder coat.
  3. Color: White.
- E. Construction:
  1. Insulation: 3-inch-thick, polyisocyanurate board.
    - a. R-Value: 20.0 according to ASTM C1363.
  2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
  3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
  4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
  5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

6. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
- F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
  1. Provide two-point latch on lids larger than 84 inches.
  2. Provide remote-control operation.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
  1. Height: 42 inches above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
  3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
  4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  7. Fabricate joints exposed to weather to be watertight.
  8. Fasteners: Manufacturer's standard, finished to match railing system.
  9. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: Safety yellow.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
  1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  2. Height: 42 inches above finished roof deck.
  3. Material: Steel tube.
  4. Post: 1-5/8-inch-diameter pipe.
  5. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: Safety yellow.

## 2.4 PIPE PORTALS

- A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.
- B. Flashing Pipe Portal: Formed aluminum membrane-mounting flashing flange and sleeve with collared opening and pressure-sealed conically shaped EPDM protective rubber cap sized for piping indicated, with stainless-steel snaplock swivel clamps.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Roof Products and Systems (RPS); a division of Hart & Cooley, Inc.

## 2.5 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and perforated metal collar.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Custom Solution Roof and Metal Products.
    - b. Thaler Metal Industries Ltd.
  2. Metal: Aluminum sheet, 0.063 inch thick.
  3. Diameter: As indicated on Drawings.
  4. Finish: Manufacturer's standard.

## 2.6 METAL MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.
  1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
  2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, AZ50 coated.
  1. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
- C. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- D. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- E. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.
- F. Steel Tube: ASTM A500/A500M, round tube.
- G. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.
- H. Steel Pipe: ASTM A53/A53M, galvanized.

## 2.7 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Underlayment:
  1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
- F. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- G. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- H. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

- I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.
- J. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 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 the Work.
- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- D. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

- E. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.
- B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting."
- C. Clean exposed surfaces according to manufacturer's written instructions.
- D. Clean off excess sealants.
- E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

## SECTION 078413 - PENETRATION FIRESTOPPING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

## B. Related Sections:

1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance rated constructions.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product indicated.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

## 1.3 INFORMATIONAL SUBMITTALS

## A. Qualification Data: For qualified Installer.

## B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

## C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

## 1.4 QUALITY ASSURANCE

## A. Installer Qualifications: A single firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1. Fire Penetration Materials and Installers shall be a single source to be subcontracted to the General Contractor.

## B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:



1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
  - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
  - b. Classification markings on penetration firestopping correspond to designations listed by the following:
    - 1) UL in its "Fire Resistance Directory."
    - 2) Intertek ETL SEMKO in its "Directory of Listed Building Products."
    - 3) FM Global in its "Building Materials Approval Guide."

C. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

#### 1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be included in the Project include, but are not limited to, the following:
  1. 3M Fire Protection Products.
  2. Hilti, Inc.
  3. Specified Technologies, Inc.
  4. Tremco, Inc.
- B. Source Limitations: Provide penetration firestopping and fire-resistive joint system products of a single manufacturer.

## 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Composite Wood or Agrifiber Products.
  3. Low-Emitting Materials: Insulation.
  4. Low-Emitting Materials: Field applied interior paints and coatings.

## 2.3 PENETRATION FIRESTOPPING

- A. Where indicated and where additionally required by authorities having jurisdiction, provide penetration firestopping that is 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. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
  2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
  2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or 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.

## 2.4 FILL MATERIALS

- A. 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.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. 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.
- H. 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. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. 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 sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

## 2.5 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping 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 the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with 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 penetration firestopping.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. 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 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 penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

#### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming 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 firestopping.
- C. Install fill materials for firestopping 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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.
- B. Fire Resistive Wall Assembly Labeling: At related locations, provide labeling on fire-resistive wall and partitions at locations, spacing, and size required by authorities having jurisdiction.

### 3.5 FIELD QUALITY CONTROL

- A. Engage a qualified testing agency to perform tests and inspections and issue reports.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping 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 penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION

## SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

## B. Related Sections:

1. Division 07 Section "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
2. Division 07 Section "Expansion Control" for fire-resistive architectural joint systems.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product indicated.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.

1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

## 1.3 INFORMATIONAL SUBMITTALS

## A. Qualification Data: For qualified Installer.

## B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

## C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

## 1.4 QUALITY ASSURANCE

## A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1. Same installer as Work specified in Division 07 Section "Penetration Firestopping."

## B. Installer Qualifications: A firm experienced in installing fire-resistive joint 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 fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

- C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
  2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
    - a. Fire-resistive joint system products bear classification marking of qualified testing agency.
    - b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 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, frost, condensation, or other causes.
- B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

#### 1.6 COORDINATION

- A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
- B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
- C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

### PART 2 - PRODUCTS

#### 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Composite Wood or Agrifiber Products.
  3. Low-Emitting Materials: Insulation.

#### 4. Low-Emitting Materials: Field applied interior paints and coatings.

### 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M Fire Protection Products.
  - 2. Hilti, Inc.
  - 3. Specified Technologies, Inc.
  - 4. Tremco, Inc.
- B. Source Limitations: Provide fire-resistive joint system products of a single manufacturer.

### 2.3 FIRE-RESISTIVE JOINT SYSTEMS

- A. Where indicated and where additionally required by authorities having jurisdiction, 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 assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
  - 1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies, including expansion joints in assemblies.
  - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
- C. Joints at Exterior Curtainwall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg or ASTM E 2307.
  - 1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
- D. Joints in Smoke Barriers: Provide joint firestopping systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.
  - 1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.
- E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- F. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing 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 the Work.
- B. 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.
  - 3. Remove laitance and form-release agents from concrete.
- 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.
- C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming 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.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply fill materials so they contact and adhere to substrates formed by joints.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.
- C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to joints as the 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 joints 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.

END OF SECTION

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## SECTION 079200 - JOINT SEALANTS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

## B. Related Requirements:

1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. 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.
- D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- E. Joint-Sealant Schedule: Include the following information: use designations used in this Section:
  1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- B. Manufacturer Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- C. Field-Adhesion-Test Reports: For each sealant application tested.
- D. Sample Warranties: For special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.
- C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
  - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone, masonry, or exposed concrete substrates.
  - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
  - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
  - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each kind of sealant and joint substrate.
  - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

- a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
  - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.7 FIELD 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 or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace 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.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

## 2.1 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As scheduled, or if not scheduled, as selected by Architect from manufacturer's full range.

## 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

- 1. Low-Emitting Materials: Adhesives and Sealants.

## 2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.
- C. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

## 2.4 URETHANE JOINT SEALANTS – INTERIOR USE

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT. Paintable.
- B. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT. Paintable.
- C. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
- D. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

## 2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

## 2.6 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

## 2.7 LATEX JOINT SEALANTS

- A. Acrylic Latex: Siliconized acrylic latex, ASTM C834, Type OP, Grade NF. Paintable.

## 2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, types as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.9 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 performance of the Work.



- 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, 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. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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 or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 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 C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind 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 bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. 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.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
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 profile per Figure 8A in ASTM C1193 unless otherwise indicated.
    - 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.6 EXTERIOR JOINT-SEALANT SCHEDULE

- A. Exterior perimeter joints between concrete or masonry and frames of doors, windows, and louvers.
1. Joint Sealant: Single-component neutral-curing non-sag non-staining silicone sealant; Movement Class 50/50.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range. Multiple colors required to match several conditions.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range. Multiple colors required to match several conditions.

B. Concealed Mastics: At aluminum thresholds.

1. Joint Sealant: Butyl-rubber.

3.7 INTERIOR JOINT-SEALANT SCHEDULE

A. Vertical control and expansion joints on exposed interior painted gypsum board surfaces of exterior wall.

1. Joint Sealant: Single component nonsag urethane sealant.
2. Joint-Sealant Color: Custom match to adjacent wall color, or paintable product.

B. Interior perimeter joints of exterior openings.

1. Joint Sealant: Single component nonsag urethane sealant.
2. Joint-Sealant Color: Custom match to adjacent wall color, or paintable product.

C. Vertical joints on exposed surfaces of interior unit masonry.

1. Joint Sealant: Single component nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range, to match multiple conditions, or paintable product.

D. Perimeter non-moving joints between interior painted surfaces and adjacent materials.

1. Joint Sealant: Siliconized acrylic sealant.
2. Joint-Sealant Color: White; paintable.

E. Traffic joints in floor and between floor and wall construction.

1. Joint Sealant: Multicomponent pourable urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION

## SECTION 079219 - ACOUSTICAL JOINT SEALANTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes acoustical joint sealants.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

## 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

- 1. **Low-Emitting Materials: Adhesives and Sealants.**

## 2.3 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the the Project include, but are not limited to, the following:
    - a. Pecora Corporation; AC-20 FTR.
    - b. Tremco Incorporated; Tremco Acoustical Sealant.
    - c. USG Corporation; SHEETROCK Acoustical Sealant.

## 2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- 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 acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. 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 or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears.

#### 3.3 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.
- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.
- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

#### 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 acoustical joint sealants and of products in which joints occur.

#### 3.5 PROTECTION

- A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

## B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 088000 "Glazing" for safety glazing installed in hollow metal doors and frames.

## 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

## 1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

## 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

- B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.

9. Details of moldings, removable stops, and glazing.

- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.

- B. Field quality control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

1. Provide additional protection to prevent damage to 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 doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

- B. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.37 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

- C. Sound Rating: Provide frame assemblies and frame plus door assemblies identical to those of assemblies tested as sound-retardant units by an acoustical testing agency, and have the following minimum rating:



1. STC Rating: As indicated in the Door Schedule as calculated by ASTM E413 when tested in an operable condition according to ASTM E90.
- D. Wind Loads: Provide exterior hollow metal assemblies capable of withstanding wind load design pressures for Project indicated on Structural drawings.
- E. Windborne-Debris-Impact-Resistance Performance: Provide exterior hollow metal systems that pass missile-impact and cyclic-pressure tests when tested according to SEI/ASCE-7.
  1. Large-Missile Impact: For hollow metal systems located within 30 feet of grade.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ceco Door; ASSA ABLOY.
  2. Curries Company; ASSA ABLOY.
  3. Deansteel Manufacturing Company, Inc.
  4. Fleming Door Products Ltd.; Assa Abloy Group Company.
  5. Mesker Door Inc.
  6. Pioneer Industries.
  7. Republic Doors and Frames.
  8. Steelcraft; an Allegion brand.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B.
  1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - a. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - b. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, at wet locations including group toilet rooms, locker rooms, janitor's closets, mechanical rooms.
    - c. Edge Construction: Model 2, Seamless.
    - d. Edge Bevel: Provide manufacturer's standard beveled or square edges.
    - e. Core: Manufacturer's standard.
    - f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.
  2. Frames:
    - a. Materials: Uncoated and Metallic-coated steel sheet, minimum thickness of 0.053 inch.

- b. Interior Frames for Sound Rated Openings: Fabricate from cold-rolled steel sheet unless otherwise indicated, 0.053 nominal thickness or thicker as required to provide STC rating indicated.
- c. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
- d. Construction: Full profile welded.

3. Exposed Finish: Prime.

#### 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.

1. Doors:

- a. Type: As indicated in the Door and Frame Schedule.
- b. Thickness: 1-3/4 inches.
- c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
- d. Edge Construction: Model 2, Seamless.
- e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
- g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
- h. Core: Polyurethane.
- i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
- b. Construction:
  - 1) Thermally broken.
  - 2) Full profile welded.

3. Exposed Finish: Prime.

#### 2.5 BORROWED LITES

- A. Fabricate of uncoated and metallic-coated steel sheet, minimum thickness of 0.042 inch.
- B. Construction: Face welded.

- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

## 2.6 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

## 2.7 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.8 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
  - 1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
  - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  - 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
  - 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  - 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## 2.9 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

## 3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  - 2. Fire-Rated Openings: Install frames according to NFPA 80.
  - 3. Floor Anchors: Secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 4. Metal-Stud Partitions: Fully fill frames with mineral-fiber insulation.
  - 5. Masonry Walls: Do not fill frames with grout.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus, or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus, or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus, or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus, or minus 1/16 inch, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  - 1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
  2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

### 3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

## SECTION 081416 - FLUSH WOOD DOORS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Five- and seven- ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

## B. Related Requirements:

1. Section 088000 "Glazing" for glass view panels in flush wood doors.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory- finishing specifications.

- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
2. Details of frame for each frame type, including dimensions and profile.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems, if any.
4. Dimensions and locations of blocking for hardware attachment.
5. Dimensions and locations of mortises and holes for hardware.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Doors to be factory finished and application requirements.

## D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. Apply finishes to corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Special warranties.

## 1.6 QUALITY ASSURANCE

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top rail with opening number used on Shop Drawings.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

## 1.9 WARRANTY

- A. Special Warranty: 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. Delamination of veneer.
    - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide [Masonite Architectural, Aspiro Series](#); or comparable products by one of the following:
  - 1. Oshkosh Door Company.
  - 2. Oregon Door.
  - 3. VT Industries Inc.



- B. Source Limitations: Obtain flush wood doors from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

## 2.3 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
  - 1. Low-Emitting Materials: Adhesives and Sealants.
  - 2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

## 2.4 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
  - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

## 2.5 SOLID-CORE FIVE-PLY OR SEVEN-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Doors:
  - 1. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
  - 2. ANSI/WDMA I.S. 1A Grade: Premium.
  - 3. Faces: Single-plywood veneer not less than 1/50 inch thick or two-ply wood panel with wood veneer not less than 1/50 inch thick.
    - a. Species: Match existing doors.
    - b. Cut: Plain sliced (flat sliced).
    - c. Match between Veneer Leaves: Slip match.
    - d. Assembly of Veneer Leaves on Door Faces: Running match.
    - e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  - 4. Exposed Vertical Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
    - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
    - b. Fire-Rated Pairs of Doors: 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.
- c. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 475 lbf in accordance with WDMA T.M. 10.
5. Core for Non-Fire-Rated Doors:
- a. ANSI A208.1, Grade LD-2 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
    - 2) Provide doors with WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."
  - b. WDMA I.S. 10 structural composite lumber. (Contractor option)
    - 1) Screw Withdrawal, Door Face: 550 lbf.
    - 2) Screw Withdrawal, Vertical Door Edge: 550 lbf.
6. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.6 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
  1. Wood Species: Same species as door faces.
  2. Profile: Square to match existing.
  3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- C. Metal Frames for Lite Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish in color selected by Architect; and approved for use in doors of fire-protection rating indicated on Drawings.

## 2.7 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
  - 1. Locate hardware to comply with DHI-WDHS-3.
  - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  - 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
  - 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Transom and Side Panels:
  - 1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
  - 2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
  - 3. Fabricate door and transom panels with full-width, solid-lumber, rabbeted, meeting rails.
  - 4. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings: Factory cut and trim openings through doors.
  - 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 Section 088000 "Glazing."

## 2.8 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
  - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 2. Finish faces, all four edges, edges of cutouts, and mortises.
  - 3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
  - 1. ANSI/WDMA I.S. 1A Grade: Premium.
  - 2. Finish: ANSI/WDMA I.S. 1A TR-6 Manufacturer's standard comparable to Catalyzed Polyurethane.
  - 3. Staining: Match Architect's sample.

4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
5. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
  1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Job-Fitted Doors:
  1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  4. Clearances:
    - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    - d. Comply with NFPA 80 for fire-rated doors.
  5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
  6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Install fire-rated doors and frames in accordance with NFPA 80.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- F. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

- G. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- H. Prepare and submit a separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

### 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

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## SECTION 083113 - ACCESS DOORS AND FRAMES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, fire ratings if applicable, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- C. Product Schedule: For access doors and frames, keyed to floor plan.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Acudor Products, Inc.
  - b. Babcock-Davis.
  - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - d. Karp Associates, Inc.
  - e. Larsens Manufacturing Company.
  - f. MIFAB, Inc.
  - g. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - h. Nystrom.
  - i. Williams Bros. Corporation of America (The).

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

## 2.3 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
  - 1. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
  - 2. Locations: Wall and ceiling.
  - 3. Door Size: 16 by 16 inches unless otherwise indicated on Drawings.

4. Metallic-Coated Steel Sheet for Door: Nominal 0.064-inch, 16 gage factory primed.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cam latch, key operated.

## 2.4 FIRE-RATED ACCESS DOORS AND FRAMES

### A. Flush Access Doors with Concealed Flanges:

1. Description: Face of door flush with frame, with concealed flange and concealed hinge.
2. Door Size: 16 by 16 inches unless otherwise indicated on Drawings.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064-inch, 16 gage, factory primed.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Cam latch, key operated.

## 2.5 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

## 2.6 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
- D. Latch and Lock Hardware:
  1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  2. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."



## 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 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.
- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

### 3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

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## SECTION 083313 - COILING COUNTER DOORS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Counter doors.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

## B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices, and other accessories.
5. Include diagrams for power, signal, and control wiring.

## C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).

## 1.3 CLOSEOUT SUBMITTALS

## A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

## A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from coiling counter door manufacturer.

## 2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cookson Company.
  - 2. Cornell.
  - 3. ENTREMATIC.
  - 4. McKeon Rolling Steel Door Company, Inc.
  - 5. Overhead Door Corporation.

## 2.3 COUNTER DOOR ASSEMBLY

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Door Curtain Material: Aluminum.
- D. Door Curtain Slats: Flat profile slats of 1-1/4-inch or 1-1/2-inch center-to-center height.
  - 1. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- E. Bottom Bar: Manufacturer's standard continuous channel shape, fabricated of material and finished to match door.
- F. Curtain Jamb Guides: Of material and with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
- G. Hood: Match curtain material and finish.
  - 1. Shape: Square.
  - 2. Mounting: Face of wall.
- H. Sill Configuration: No sill.
- I. Locking Devices: Equip door with [slide bolt for padlock] [locking device assembly] [and] [chain lock keeper].

1. Locking Device Assembly: Cremona-type, both jamb sides locking bars, operable from inside with thumb turn.
- J. Manual Door Operator: Push-up operation.
  1. Provide operator with manufacturer's standard removable operating arm.
- K. Curtain Accessories: Equip door with push/pull handles.
- L. Door Finish:
  1. Two-coat high performance organic finish per AAMA 2605.
  2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

#### 2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  1. Aluminum Door Curtain Slats: ASTM B209 sheet or ASTM B221 extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; thickness of 0.050 inch; and as required.
  2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
  1. Removable Jamb Guides: Manufacturer's standard.

#### 2.5 HOODS

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Equip hood with intermediate support brackets as required to prevent sagging.
  1. Aluminum: 0.040-inch-thick aluminum sheet complying with ASTM B209, of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

#### 2.6 CURTAIN ACCESSORIES

- A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

#### 2.7 COUNTERBALANCE MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a

spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## 2.8 MANUAL DOOR OPERATORS

- A. General: Equip door with manual door operator by door manufacturer.
- B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

## 2.9 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.10 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

### 3.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### 3.4 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### 3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance, including emergency callback service, during normal working hours.
  - 2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

### 3.6 DEMONSTRATION

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

END OF SECTION

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## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Exterior and interior storefront framing.
2. Exterior manual-swing entrance doors and door-frame units.

## B. Related Requirements:

1. Section 087100 "Door Hardware" for balance of door hardware for aluminum entries not specified in this Section.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

## B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

- a. Joinery, including concealed welds.
- b. Anchorage.
- c. Expansion provisions.
- d. Glazing.
- e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

## C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

## D. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.
- B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
  - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: If data based on previous testing within the past three years is not available submit to glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the nonstructural sealants of a structural glazed system.
  - 1. Compatibility: Test materials or components using ASTM C1087.
  - 2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
  - 3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
  - 6. Testing will not be required.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Structural failures, including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  2. Warranty Period: Five years from date of Substantial Completion.
    - a. Deterioration of metals and other materials beyond normal weathering.
    - b. Water penetration through fixed glazing and framing areas.
    - c. Failure of operating components.
  3. Warranty Period: Five years from date of Substantial Completion.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of powder coat or organic finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:

- a. Thermal stresses transferring to building structure.
  - b. Glass breakage.
  - c. Noise or vibration created by wind and thermal and structural movements.
  - d. Loosening or weakening of fasteners, attachments, and other components.
  - e. Failure of operating units.
- C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
- ## 2.2 PERFORMANCE REQUIREMENTS, EXTERIOR
- A. Structural: Test according to ASTM E330/E330M as follows:
1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceed specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- B. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for basic protection.
1. Large-Missile Test: For glazing located within 30 feet of grade.
  2. Small-Missile Test: For glazing located between 30 feet and 60 feet above grade.
- C. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
- D. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.38 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
    - b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):
  - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.27 as determined according to NFRC 200.
  - b. Entrance Doors: SHGC of not more than 0.35 as determined according to NFRC 200.
  - c. Venting Windows: Whole window SHGC of not more than 0.27 as determined according to NFRC 200.
3. Air Leakage:
  - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
  - b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
  - c. Venting Windows: Whole window air leakage of not more than 0.3 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
4. Condensation Resistance Factor (CRF):
  - a. Fixed Glazing and Framing Areas: CRF of 60 frame and 62 glass as determined according to AAMA 1503.
  - b. Entrance Doors: CRF of not less than 63 as determined according to AAMA 1503.
  - c. Venting Windows: Whole window CRF of not less than 45 as determined according to AAMA 1503.
- E. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.
  1. Large-Missile Test: For glazing located within 30 feet of grade.
- F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

### 2.3 STOREFRONT SYSTEMS

- A. Basis-of-Design Products: Subject to compliance with requirements, provide Kawneer North America; [Trifab Versaglaze 601T 6 inch deep storefront framing](#) with 500 Entrance Doors and Frames and Trifab 400 interior framing units, or a comparable product by one of the following:
  1. [U.S. Aluminum; a brand of C.R. Laurence.](#)
  2. [YKK AP America Inc.](#)
- B. Exterior Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Exterior Framing Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
  4. Finish: High-performance organic finish.
  5. Fabrication Method: Either factory- or field-fabricated system.

6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- C. Interior Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Interior Framing Construction: Non-thermal.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
  4. Finish: High-performance organic finish.
  5. Fabrication Method: Either factory- or field-fabricated system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

#### 2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: Minimum 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated, and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  2. Door Design: As indicated on Drawings. Align mid-rail centered on exit devices where applicable.
  3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.

#### 2.5 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
- B. Weather Stripping: Manufacturer's standard replaceable components.
1. Compression Type: Made of ASTM D 2000, molded neoprene.
- C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

- D. Door Hardware: Balance of door hardware specified in Section 087100.

## 2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: Comply with Section 088000 "Glazing."
- D. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.
  - 1. Color: As selected by Architect from manufacturer's full range of colors.

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
- D. Structural Profiles: ASTM B308/B308M.
- E. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
  - 4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.
- E. Rigid PVC Filler: to improve installation of backer rod and perimeter sealant by providing support for backer rod.
- F. Waterproof Underlayment, Self-Adhered: Refer to Section 076200 "Sheet Metal Flashing and Trim."
- G. Window Opening Fluid-Applied Flashing: One-component air barrier and waterproofing material for protection of masonry rough openings.
  1. Product: Sto Corp., [StoGuard Rapidseal](#).

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
  6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
  2. At exterior doors, provide weather sweeps applied to door bottoms.



- G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.10 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
  - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color and Gloss: Match Architect's sample.

## 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 the Work.
- B. 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 and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing as specified in Section 088000 "Glazing."

- F. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.3 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
  - 1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  - 2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  - 3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
  - 4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
    - b. Prepare test and inspection reports.
  - 2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION

## SECTION 085113 - ALUMINUM WINDOWS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes aluminum windows for exterior locations.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing of other aluminum work for color and finish matching.
  - 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
  - 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
  - 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: For aluminum windows.
  - 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
  - 2. Include isometric drawing illustrating installation of windows in existing openings, with attention to flashing and sealants.
- C. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
  - 1. Exposed Finishes: 2 by 4 inches.
  - 2. Exposed Hardware: Full-size units.
- D. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranties: For manufacturer's warranties.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Mockups: Build in-place mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Build mockup of typical wall area as shown on Drawings.
  - 2. Complete installation including treatment of exposed lintel, joint sealants, flashings, and interior finish treatments.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of existing rough openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to meet performance requirements.
    - b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
    - c. Faulty operation of movable sash and hardware.
    - d. Deterioration of materials and finishes beyond normal weathering.
    - e. Failure of insulating glass.
  - 2. Warranty Period:
    - a. Window: 10 years from date of Substantial Completion.
    - b. Glazing Units: 10 years from date of Substantial Completion.
    - c. Aluminum Finish: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

## 2.2 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Window Certification: AAMA certified with label attached to each window.
- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - 1. Minimum Performance Class: CW.
  - 2. Minimum Performance Grade: 70.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.32 Btu/sq. ft. x h x deg F.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.27.
- E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- F. Thermal Movements: Provide aluminum windows, including anchorage, 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. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.
- G. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection.
  - 1. Large-Missile Test: For glazing located within 30 feet of grade.

## 2.3 ALUMINUM WINDOWS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Quaker Window Products, Inc.; H450 or a comparable product by one of the following:
  - 1. Winco.
- B. Types: Provide the following types in locations indicated on Drawings:
  - 1. Fixed, awning.
- C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.
  - 1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

- D. Windborne-Debris-Impact-Resistant Insulating-Glass Units: ASTM E2190 with two lites and complying with impact-resistance requirements in "Window Performance Requirements" Article.
1. Exterior Lite: ASTM C1036, Type 1, Class 1, q3.
    - a. Tint: Clear.
    - b. Kind: Fully tempered.
  2. Interior Lite: ASTM C1172 clear laminated glass with two plies of float glass.
    - a. Float Glass: As required by performance requirements indicated.
    - b. Interlayer Thickness: As required by performance requirements indicated.
  3. Filling: Fill space between glass lites with air.
  4. Low-E Coating: Sputtered on second surface.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- F. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.
1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- G. Projected Window Hardware:
1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.
    - a. Type and Style: As selected by Architect from manufacturer's full range of types and styles.
  2. Hinges: Non-friction type, not less than two per sash.
  3. Lock: Lift-type throw, cam-action lock with keeper.
  4. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
    - a. Limit clear opening to 4 inches for ventilation; with custodial key release.
- H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

- J. Waterproof Underlayment, Self-Adhered: Refer to Section 076200 "Sheet Metal Flashing and Trim."
- K. Window Opening Fluid-Applied Flashing: One-component air barrier and waterproofing material for protection of masonry rough openings.
  - 1. Product: Sto Corp., [StoGuard Rapidseal](#).

#### 2.4 ACCESSORIES

- A. Subsills: Thermally broken, extruded aluminum subsills in configurations indicated on Drawings.

#### 2.5 FABRICATION

- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
- B. Glaze aluminum windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
- F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

#### 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual" 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.

#### 2.7 ALUMINUM FINISHES

- A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

#### 3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
  1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
  1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
  2. Water-Resistance Testing:
    - a. Test Pressure: Two-thirds times test pressure required to determine compliance with AAMA/WDMA/CSA 101/I.S.2/A440 performance grade indicated.
    - b. Allowable Water Infiltration: No water penetration.



3. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
  4. Test Reports: Prepared according to AAMA 502.
- C. Windows will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
- 3.4 ADJUSTING, CLEANING, AND PROTECTION
- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
  - B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
    1. Keep protective films and coverings in place until final cleaning.
  - C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
  - D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

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## SECTION 087100 - DOOR HARDWARE

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Mechanical door hardware for the following:
  - a. Swinging doors.
  - b. Sliding doors.
  - c. Folding doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

## 1.2 COORDINATION

## A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.

1. Cast anchoring inserts into concrete.

## B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

## C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

## D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

## E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

## 1.3 PREINSTALLATION MEETINGS

## A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

## B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

- a. Flow of traffic and degree of security required.
- b. Preliminary key system schematic diagram.
- c. Requirements for key control system.
- d. Requirements for access control.
- e. Address for delivery of keys.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
  1. Include diagrams for power, signal, and control wiring.
  2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
  1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For each type of exposed product, in each finish specified.
  1. Sample Size: Full-size units or minimum 2-by-4-inch Samples for sheet and 4-inch-long Samples for other products.
    - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
  2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of qualified Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
  2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
  3. Content: Include the following information:

- a. Identification number, location, hand, fire rating, size, and material of each door and frame.
  - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
  - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
  - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - e. Fastenings and other installation information.
  - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
  - g. Mounting locations for door hardware.
  - h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Product Certificates: For each type of electrified door hardware.
  1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.
- C. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
  1. Warehousing Facilities: In Project's vicinity.
  2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
  3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

- D. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys to Owner by registered mail or overnight package service.

#### 1.8 WARRANTY

- A. Special Warranty: 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 doors and door hardware.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

#### PART 2 - Warranty Period: Three years from date of Substantial Completion. PRODUCTS

##### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
  - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

##### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
  1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
  2. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
  3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
  4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
  5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.
- F. Hurricane Resistant Exterior Openings: Provide exterior door hardware as complete and tested assemblies, or component assemblies, including approved doors and frames specified under Section 081113 "Hollow Metal Doors and Frames", to meet the wind loads, design pressures, debris impact resistance, and glass and glazing requirements applicable to the Project.
  1. Test units according to ASTM E330, ASTM E1886, ASTM E1996 standards, certified by a qualified independent third-party testing agency acceptable to authority having jurisdiction, and bearing a third-party certification agency permanent label indicating windstorm approved product.

### 2.3 DOOR HARDWARE

- A. Provide door hardware as scheduled on the Drawings.
- B. Provide door hardware to match existing in style and finish and, if available, from the same manufacturers as existing hardware and scheduled by Architectural Hardware Consultant. Notwithstanding existing hardware types, include the following:
- C. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
- D. Lock Trim: Levers, compliant with ADA.

## 2.4 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.
1. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
    - b. Re-key Owner's existing master key system into new keying system.
  2. Keyed Alike: Key all cylinders to same change key.
- B. Keys: Nickel silver.
1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: "DO NOT DUPLICATE."

## 2.5 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
1. 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. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  2. Fire-Rated Applications:
    - a. Wood or Machine Screws: For the following:
      - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
      - 2) Strike plates to frames.
      - 3) Closers to doors and frames.



- b. Steel Through Bolts: For the following unless door blocking is provided:
  - 1) Surface hinges to doors.
  - 2) Closers to doors and frames.
  - 3) Surface-mounted exit devices.
- 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
- 4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

## 2.6 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical 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 doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Wood Doors: Comply with door and hardware manufacturers' written instructions.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface

protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
- F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
1. Do not notch perimeter gasketing to install other surface-applied hardware.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

### 3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
  2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
  3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### 3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

END OF SECTION

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## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes:

1. Glass for doors, interior borrowed lites, and entrance and storefront framing.
2. Glazing sealants and accessories.

#### 1.2 DEFINITIONS

- A. Glass Manufacturers: 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. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

#### 1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

#### 1.9 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written

instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
  2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
  3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886. Test

specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.

1. Large-Missile Test: For glazing located within 30 feet of grade.
  2. Small-Missile Test: For glazing located more than 30 feet above grade.
- E. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For monolithic glass lites, properties are based on units with lites 6 mm thick.
  2. For laminated glass lites, properties are based on products of construction indicated.
  3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

### 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
1. Minimum Glass Thickness for Exterior Lites: 6 mm unless otherwise indicated.
  2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance



Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
  - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
  - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  - 3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
  - 1. Polyvinyl butyral interlayer.

## 2.6 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  - 2. Spacer: Manufacturer's standard spacer material and construction.
  - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

## 2.7 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates,

- under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
  4. Sealants shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  5. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: One-part non-acidic moisture curing neutral-curing silicone glazing sealant complying with ASTM C 920 Class A, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 790
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700
    - c. Pecora Corporation; 890
    - d. Tremco Incorporated; Spectrem 1
  2. Applications: High movement joints at metal-to metal and glass to metal.
- C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795 or 995
    - b. GE Advanced Materials -Silicones; SilPruf NB SCS9000 or SilPruf SCS2000
    - c. Pecora Corporation; 864
    - d. Tremco Incorporated; Spectrem 2
  2. Applications: General applications in glazing installation subject to high movement including perimeter; use non-staining formula at absorbent perimeter applications.
- D. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 799
    - b. GE AdvancedMaterials-Silicones; UltraGlaze SSG4000 or UltraGlaze SSG4000AC
    - c. Tremco Incorporated; Proglaze SSG or Tremsil 600
  2. Applications: General applications in glazing installation including perimeter; use non-staining formula at absorbent perimeter applications.
- E. Glazing Sealant: Acid-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Corning Corporation; 999-A
  - b. GE Advanced Materials-Silicones; Construction SCS1200
  - c. Pecora Corporation; 860
  - d. Tremco Incorporated; Proglaze or Tremsil 200
2. Applications: For structural glazing applications including butt glazing and lap glazing.

## 2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM 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.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
  1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with 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 of 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.

## 2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation 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.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 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.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior, or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

#### 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, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right 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. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. 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 INSTALLATION OF SLIDING WINDOWS

- A. Install sliding window units in accordance with manufacturer's written recommendations and approved Shop Drawings.

### 3.8 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.

- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### 3.9 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear fully tempered float glass.
  - 1. Minimum Thickness: 6 mm.
  - 2. Safety glazing required.
  - 3. Application: Interior glazing.

### 3.10 INSULATING-LAMINATED-GLASS SCHEDULE

- A. Glass Type: Clear, Low-E-coated, Windborne Debris Impact-Resistant Insulating-Laminated-Glass Units:
  - 1. Outdoor Lite: Heat-strengthened clear float glass; fully tempered where indicated.
    - a. Thickness of Outdoor Lite: 6.0 mm.
    - b. Low-E Coating: Sputtered on second surface.
    - c. Basis-of-Design Product: Guardian Industries Corp.; SunGuard SN 54 on Clear.
  - 2. Interspace: 1/2 inch thick, air-filled.
  - 3. Indoor Lite: Two plies of Class 1 (clear) fully tempered laminated float glass.
    - a. Thickness of Plies: Not less than 4.0 mm. and as required to meet performance requirements.
    - b. Interlayer: Clear of thickness required to meet performance requirements.
  - 4. Visible Light Transmittance: 54 percent minimum.
  - 5. Reflectance (Out): 13 percent maximum.
  - 6. Winter Nighttime U-Factor: 0.28 maximum.
  - 7. Solar Heat Gain Coefficient: 0.28 maximum.
  - 8. Application: Exterior.
  - 9. Provide safety glazing labeling.

END OF SECTION

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## SECTION 088300 - MIRRORS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
  - 1. Film-backed glass mirrors qualifying as safety glazing.
- B. Related Information:
  - 1. Section 102800 "Toilet and Bath Accessories" for framed toilet accessory mirrors.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- D. Samples: For each type of the following:
  - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
  - 2. Mirror Trim: 12 inches long.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

## 1.4 CLOSEOUT SUBMITTALS

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

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Binswanger Glass Company, Inc.; a division of Vitro Architectural Glass.
  2. Gardner Glass, Inc.
  3. Guardian Glass LLC.
  4. Lenoir Mirror Company.
  5. Virginia Mirror Company, Inc.
- B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- C. Source Limitations for Mirror Accessories: Obtain mirror-glazing accessories from single source.

#### 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
  1. **Low-Emitting Materials: Adhesives and Sealants.**

#### 2.3 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.
- B. Annealed Monolithic Glass Mirrors: Mirror Quality, clear.
  1. Nominal Thickness: Minimum 4.0 mm.

- C. Safety Glazing Products: For film-backed mirrors, provide products that comply with 16 CFR 1201, Category II.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

#### 2.5 MIRROR HARDWARE

- A. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
  - 1. Bottom and Top Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.
  - 2. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

#### 2.6 FABRICATION

- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

### 3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

### 3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
  - 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  - 1. Aluminum J-Channels: Provide setting blocks 1/8-inch-thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4-inch-wide by 3/8 inch long at bottom channel.
  - 2. Install mastic as follows:
    - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
    - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

### 3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

## SECTION 089119 - FIXED LOUVERS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Fixed extruded-aluminum and formed-metal louvers.

## 1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations, where applicable.

## D. Samples: For each type of metal finish required.

## E. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.4 INFORMATIONAL SUBMITTALS

## A. Sample Warranties: For manufacturer's special warranties.

## 1.5 QUALITY ASSURANCE

## A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer and Installer agrees to repair or replace components of fixed louvers that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

- 1. Failures include, but are not limited to, the following:

- a. Structural failures, including, but not limited to, excessive deflection.
- b. Noise or vibration created by wind and thermal and structural movements.
- c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

- 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty, High-Performance Coating Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of powder coat or organic finishes within specified warranty period.

- 1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
- b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
- c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

- 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

- C. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade shall pass basic protection, when tested according to AMCA 540.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on HVAC drawings or a comparable product by one of the following:
    - a. Airolite Company, LLC (The).
    - b. American Warming and Ventilating; a Mestek Architectural Group company.
    - c. Construction Specialties, Inc.
    - d. Carnes Company.
    - e. Greenheck Fan Corporation.
    - f. Industrial Louvers Inc.
    - g. Ruskin Company.
  - 2. Louver Depth: 5 inches.
  - 3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
  - 4. Louver Performance Ratings:
    - a. Free Area: Not less than 6.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
    - b. Air Performance: Not more than 0.10-inch wg static pressure drop at 800-fpm free-area velocity.
    - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 500 fpm.
  - 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

### 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Bird screening.
- B. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
  2. Finish: Same finish as louver frames to which louver screens are attached.
  3. Type: Rewireable frames with a driven spline or insert.
- C. Louver Screening for Aluminum Louvers:
1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  3. For color-finished louvers, use fasteners with heads that match color of louvers.
- D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## 2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Horizontal Mullions: Provide horizontal mullions at joints.
- C. Maintain equal louver blade spacing to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
1. Frame Type: Channel unless otherwise indicated.



- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: Match finish selected for Section 085113 "Aluminum Windows."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

## SECTION 090160 – MAINTENANCE OF TERRAZZO FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Repair of existing terrazzo flooring and treads.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for specific requirements relating to selectively demolishing construction, which impacts the existing terrazzo flooring.
2. Section 0557100 "Decorative Metal Stairs" for new epoxy resin terrazzo stair treads.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:

1. Divider strips.
2. Control-joint strips.
3. Expansion-joint strips.
4. Terrazzo patterns.

- C. Samples: For each exposed product and for each color and texture specified, 12 by 12 inches in size.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Material Certificates: For each type of terrazzo material or product.

#### 1.5 QUALITY ASSURANCE

- A. Terrazzo-Repair Specialist Qualifications: A qualified terrazzo specialist, experienced in repairing, and replacing historic terrazzo in whole and in part. Firm shall have completed a minimum of five recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work. Experience only in applying terrazzo in new construction is insufficient experience for repairing existing historic terrazzo.

- B. Mockups: Initial installation shall serve as mockup to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Maintain interior ambient temperature above 50 deg F for 48 hours before and during terrazzo installation.
- B. Close spaces to traffic during terrazzo installation and for not less than 24 hours after installation unless manufacturer recommends a longer period.
- C. Control and collect water and dust produced by portland cement terrazzo grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

#### 2.3 PORTLAND CEMENT TERRAZZO

- A. Materials:
  1. Portland Cement: ASTM C150/C150M, Type 1.
  2. Water: Potable.
  3. Sand: ASTM C33/C33M.
  4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
  5. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
  6. Underbed Bonding Agent: Neat portland cement paste.
  7. Topping Bonding Agent: Neat portland cement paste, or epoxy or acrylic bonding agents formulated for use with monolithic terrazzo.

8. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire 2 by 2 inches by 0.062 inch in diameter, complying with ASTM A1064/A1064M, except for minimum wire size.
9. Isolation Membrane: Polyethylene sheeting, ASTM D2103, Type 13300, 4 mils thick; or unperforated asphalt felt, ASTM D226/D226M, Type I (No. 15).

B. Mixes:

1. Underbed Mix: One-part portland cement to four parts sand and sufficient water to provide workability at as low a slump as possible.
2. Terrazzo Topping Mix: One 94-lb bag of portland cement per 200 lb of aggregate, matrix pigment if required by mix color, and sufficient water to produce a workable mix.
  - a. Mix Color and Pattern: Match existing or Architect's design reference sample, if available.

## 2.4 STRIP MATERIALS

- A. Provide divider strips and control joint strips where indicated on work plan as required to alleviate stresses and prevent future cracking.
- B. Provide divider strips of width, material and finish to match existing, unless noted otherwise.
- C. Control-Joint Strips: Separate, double L-type angles, positioned back-to-back, that match material and color of divider strips and in depth required for topping thickness indicated.

## 2.5 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Recommended by manufacturer for this use.
- B. Anchoring Devices:
  1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
- C. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
- D. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's written recommendations for terrazzo type indicated.
  1. Surface Friction: Not less than 0.6 according to ASTM D2047.
  2. Acid-Base Properties: With pH factor between 7 and 10.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, to identify extent of work and conditions affecting performance of the Work. Installer may remove divider strips and terrazzo in deteriorated areas to analyze cause of cracking and condition of underlayment.

## 3.2 PREPARATION

- A. Clean existing terrazzo and strip existing sealers and polish, if any, in accordance with written recommendations from NTMA. Use neutral cleaner and allow sufficient dwell time to loosen dirt and foreign matter. Do not allow cleaner to dry on floor.
  - 1. Use maintenance equipment and pads recommended by manufacturer.
  - 2. Rinse and repeat, if necessary, and remove all residue.
- B. Provide clean, dry, and neutral substrate for terrazzo application.
- C. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
  - 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

## 3.3 INSTALLATION, GENERAL

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; noncumulative.

## 3.4 POURED-IN-PLACE TERRAZZO INSTALLATION

- A. Cut out damaged terrazzo where indicated on approved Shop Drawings to install new divider and/or expansion strips and install new terrazzo flooring.
- B. Underbed Preparation:
  - 1. Sand-Cushion Portland Cement Terrazzo: Saturate underbed with water to produce a cement slurry.
  - 2. Bonded Portland Cement Terrazzo: Dampen underbed with water.
- C. Monolithic Portland Cement Terrazzo: Apply topping bonding agent on concrete substrate.
- D. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips. Seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Roll and compact surface until excess cement and water have been extracted.

1. Portland Cement Terrazzo: Trowel to a dense, uniform, flat surface disclosing lines of divider strips.
- E. Portland Cement Terrazzo Finishing: Cover terrazzo topping with moisture-retaining cover and cure until topping develops sufficient strength to prevent lifting or pulling of aggregate during grinding.
1. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond plates.
  2. Grouting: After rough grinding, clean terrazzo topping with water and rinse away residue. Remove excess rinse water, apply matrix mix to grout surface, and fill voids. After grouting, cover surface with moisture-retaining cover to cure grout until ready for fine grinding.
  3. Fine Grinding and Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with diamond abrasives until grout is removed from surface and surface finish matches existing.

### 3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

### 3.6 PRECAST TERRAZZO INSTALLATION

- A. Install precast terrazzo units using method recommended in writing by NTMA and manufacturer unless otherwise indicated.
- B. Do not install units that are chipped, cracked, discolored, or improperly finished.

### 3.7 CLEANING AND PROTECTION

- A. Terrazzo Cleaning:
1. Remove grinding dust from installation and adjacent areas.
  2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to both NTMA's and manufacturer's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Sealing:
1. Seal surfaces according to NTMA's written recommendations.
  2. Apply sealer according to sealer manufacturer's written instructions.
- C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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## SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Gypsum board shaft wall assemblies.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

## 1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

## 1.4 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

## 2.2 SUSTAINABLE DESIGN REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Insulation.

### 2.3 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated on Drawings.
- B. STC Rating: As indicated on Drawings.
- C. Gypsum Shaftliner Board:
  1. Moisture- and Mold-Resistant Type X: ASTM C1396/C1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D3273 mold-resistance score of 10 as rated according to ASTM D3274, 1 inch thick, and with double beveled long edges.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
  1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A653/A653M, G40 unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  1. Depth: As indicated.
  2. Minimum Base-Metal Thickness: 0.030 inch.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  1. Minimum Base-Metal Thickness: Matching steel studs.
- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- H. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board," or Cementitious backer units as specified in Section 092900 "Gypsum Board" where applicable.
- I. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

### 2.4 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
- B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

- D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
  - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
  - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
- E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).
- F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."
- G. Gypsum Board Cants:
  - 1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 1/2- or 5/8-inch panels.
  - 2. Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."
  - 3. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies, frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- G. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, locate according to ASTM C840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- I. Gypsum Board Cants: At projections into shaft exceeding 4 inches, install gypsum board cants covering tops of projections.
  1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
  2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

## B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing framing members.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product.

## B. Manufacturer Stud Height and Deflection Limitation Charts: Manufacturer's standard charts with applicable selected studs indicated, consistent with minimum requirements in Part 2.

## C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Include manufacturer's published limiting height tables to demonstrate that framing members submitted meet manufacturer's specifications for loading, partition height, stud spacing, and deflection limits indicated.

## 1.3 QUALITY ASSURANCE

## A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

## 1.4 DELIVERY, STORAGE, AND HANDLING

## A. Notify manufacturer of damaged materials received prior to installation.

## B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

## C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by building code.
- E. Horizontal Deflection Limits:  $L/240$ , except  $L/360$  for partitions faced with tile.

## 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.
  - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvanized products are unacceptable.
    - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Conventional Studs and Track: AISI S220.
  - 1. Steel Studs and Tracks:
    - a. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection, but not less than 0.0296.
    - b. Minimum Base-Steel Thickness: At framing to receive cementitious tile backer units or impact-resistant gypsum board: 0.0329 inch.
    - c. Depth: As indicated on Drawings.
- C. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
  - 1. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
  - 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection, but not less than 0.0190.
  - 3. Depth: As indicated on Drawings.

- D. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 2-inch minimum vertical movement.
  2. Single Long-Leg Track System: ASTM C645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: 0.0538 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inches.
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Steel Thickness: 0.0296 inch.
  2. Depth: As indicated on Drawings.
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 3/4 inch.
  2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
  3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

### 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:

1. Post-Installed Anchors, Torque-controlled, expansion anchor: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or AC193 as appropriate for the substrate.
  2. Post-Installed Anchors, torque-controlled, adhesive anchor or adhesive anchor: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC58 or AC308 as appropriate for the substrate.
  3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
  4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
  5. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch not less than HW 12/0.1055 inch in diameter and meeting CISCA standard for the applicable seismic zone and the suspension system manufacturer's written recommendations.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
1. Depth: 2 inches, unless otherwise indicated on Drawings.
- F. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  2. Steel Studs and Tracks: ASTM C645.
    - a. Minimum Base-Steel Thickness: 0.0269 inch.
    - b. Depth: As indicated on Drawings.
  3. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.
    - a. Minimum Base-Steel Thickness: 0.0190 inch.
    - b. Depth: As indicated on Drawings.
  4. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
    - a. Minimum Base-Steel Thickness: 0.0296 inch.
- 2.4 AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Resilient Furring Channels: Steel sheet members designed to reduce sound transmission.
1. Product: [ClarkDietrich, RC Deluxe \(RCSD\)](#).



2. Configuration: Single leg.
- C. Isolation Strip at Exterior Walls: Provide the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch-thick, in width to suit steel stud size.
- D. Outlet Box Isolation Pad: Resilient acoustical and fire-resistant wall opening protective material for isolation and sealing of electrical outlets in wall construction, UL-classified.
1. Basis of Design Product: Kinetics Noise Control, Inc., Isobacker Acoustical Outlet Backer Putty Pad [www.kineticsnoise.com/arch/isobacker.html](http://www.kineticsnoise.com/arch/isobacker.html).

### 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

#### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

## 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Multilayer Application: 24 inches o.c. unless otherwise indicated.
  - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. 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 in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
  - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches o.c.
  - 2. Carrying Channels (Main Runners): 48 inches o.c.
  - 3. Furring Channels (Furring Members): 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend 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 suspension system.
    - a. 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 locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, 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 attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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## SECTION 092400 - CEMENT PLASTERING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Exterior cement plaster (stucco) over sheathing and stud framing.
2. Accessories.

#### 1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. Metal lath.
2. Base-coat cement plaster.
3. Cement plaster finish coats.
4. Accessories.

- ##### B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

- ##### C. Samples: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- ##### A. Store materials inside under cover and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

#### 1.5 FIELD CONDITIONS

- ##### A. Comply with ASTM C926 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.
2. Apply plaster when ambient temperature is greater than 40 deg F.
3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

- ##### C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

## PART 2 - PRODUCTS

## 2.1 SOURCE LIMITATIONS

- A. Obtain plaster materials from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance in accordance with ASTM E119 by a qualified testing agency.

## 2.3 METAL LATH

- A. Expanded-Metal Lath: ASTM C847, cold-rolled carbon-steel sheet with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
  - 1. Diamond-Mesh Lath: Self-furring, 2.5 lb/sq. yd.
- B. Paper Backing: FS UU-B-790a, Type I, Grade D, Style 2 vapor-permeable paper.
  - 1. Provide paper-backed lath at exterior locations.

## 2.4 BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926 for applications indicated.
- B. Base-Coat Mixes for Use over Metal Lath: Portland Cement mixes. Scratch and brown coats for three-coat plasterwork over sheathing.

## 2.5 CEMENT PLASTER FINISH COATS

- A. Provide one of the following at Contractor's option.
- B. Job-Mixed Finish-Coat Mixes:
  - 1. Portland Cement Mix: For cementitious materials, mix 1-part portland cement and 1-1/2 to 2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
  - 2. Portland and Masonry Cement Mix: For cementitious materials, mix 1-part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
- C. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

## 2.6 ACCESSORIES

- A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
- B. Metal Accessories:

1. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
  2. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
- C. Plastic Accessories: Manufactured from high-impact PVC.
1. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
    - a. Square-edge style; use unless otherwise indicated.
    - b. Bullnose style, radius 3/4-inch minimum; use at locations indicated on Drawings.
  2. Control Joints: 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.
  3. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged 1/2-inch-wide reveal; with perforated concealed flanges.
  4. Foundation Weep Screeds: With perforated sloped flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.

## 2.7 PLASTER MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I.
- B. Lime: ASTM C206, Type S; or ASTM C207, Type S.
- C. Sand Aggregate: ASTM C897.
- D. Engineered Performance Mix: Factory mixed and packaged mix requiring only the addition of water at the job site. Available manufacturers offering products that may be incorporated into the Project are listed on the website of the Stucco Manufacturers Association: <https://stuccomfgassoc.com/the-sma/member-directory/>
  1. Amerix, an OldCastle APG Brand.
  2. Omega Products.
  3. Parex.
  4. Master Wall, Inc.

## 2.8 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.
- C. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster in accordance with ASTM C926.

## 3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

## 3.4 INSTALLATION OF METAL LATH

- A. Metal Lath: Install in accordance with ASTM C1063.
  - 1. Partition Framing and Vertical Furring: Install flat-diamond-mesh lath.

## 3.5 INSTALLATION OF ACCESSORIES

- A. Install in accordance with ASTM C1063 and at locations indicated on Drawings.
- B. Reinforcement for External (Outside) Corners:
  - 1. Install lath-type, external-corner reinforcement at exterior locations.
- C. Control Joints: Locate as approved by Architect for visual effect and as follows:
  - 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.

## 3.6 APPLICATION OF BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926.



1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when 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. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with 3/4-inch total thickness, as follows:
1. Portland cement mixes.
  2. Engineered mix.

### 3.7 APPLICATION OF CEMENT PLASTER FINISH COATS

- A. Plaster Finish Coats: Apply to provide finish to match Architect's sample.

### 3.8 REPAIR

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

### 3.9 CLEANING

- A. Remove temporary protection and enclosure of other work after plastering is complete.
- B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.
- C. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION

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## SECTION 092900 - GYPSUM BOARD

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

## B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 079219 "Acoustical Joint Sealants" for acoustical joint sealants installed in gypsum board assemblies.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For specified products.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

## C. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

## D. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

## 1.3 DELIVERY, STORAGE AND HANDLING

## A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.4 FIELD CONDITIONS

## A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

## B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

## C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

### 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Walls.
  3. Low-Emitting Materials: Ceilings.
  4. Low-Emitting Materials: Insulation.

### 2.3 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.4 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C1396/C1396M.
  1. Thickness: 5/8 inch.
  2. Long Edges: Tapered.
- B. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
  1. Core: 5/8-inch, Type X.
  2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
  3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
  4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
  5. Long Edges: Tapered.
  6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- C. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
  1. Core: 5/8-inch, Type X.
  2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.

3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements.
5. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 3 requirements according to test in Annex A1.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.5 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.
1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
  2. Long Edges: Tapered.

## 2.6 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - a. CertainTeed Corporation; FiberCement BackerBoard.
    - b. National Gypsum Company; PermaBase® Cement Board.
    - c. USG Corporation; USG Durock® Brand Cement Board.
  2. Thickness: 5/8 inch.
  3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

## 2.7 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
1. Material: Plastic.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. USG Compasso.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.

## 2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: 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 or drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound or drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
  1. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.9 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
  1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Utilize mineral wool products.

- 2. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install 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.
- D. 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.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: Vertical surfaces unless otherwise indicated.
  - 2. Abuse-Resistant and Mold-Resistant Type: On walls unless otherwise indicated.
  - 3. Impact-Resistant Type: At locations indicated on Drawings.
  - 4. Type C: Where required for specific fire-resistance-rated assembly indicated.
- B. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to 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 panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
  - 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
  - 2. 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.

### 3.4 INSTALLATION OF TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.



- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 INSTALLATION OF 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 according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings.
- E. Moisture Barrier Trim: Install in toilet rooms, janitor closets, and food preparation areas.

### 3.6 FINISHING GYPSUM BOARD

- 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 for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
  - 3. Level 5: Not required.
  - 4. Textured Surfaced: Not required.

### 3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

## SECTION 093013 - CERAMIC TILING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Glazed wall tile.

## B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for tile backing panels.

## 1.2 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

- B. Face Size: Actual tile size, excluding spacer lugs.

- C. Module Size: Actual tile size plus joint width indicated.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

## C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. **Assembled samples** mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 36 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.

3. Full-size units of each type of trim and accessory for each color and finish required.

## 1.5 INFORMATIONAL SUBMITTALS

- A. **Installation Schedule:** Provide written description of installation methods and procedures to be used at each type of installation required. Cross reference to Installation Types Schedule in Part 3. Include copies of TCNA Installation Methods cited.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated, rounded up to the nearest full carton, in a sealed and labeled carton.
  - 2. Grout: Furnish quantity of grout equal to one full package or container installed for each type, composition, and color indicated.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Experienced installer employing workers trained by manufacturer of installation materials, with record of successful performance on similar projects.
  - 2. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of product and installation types specified for Project.
- B. Mockups: Build in-place mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of each type of tile installation, when requested by Architect.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 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 requirements in ANSI A137.1 for labeling 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 can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

## 1.9 COORDINATION

- A. Coordinate locations and depth required for slab depressions for installation of ceramic tile.

1. Provide minimum 2-inch-deep slab depression at quarry tile.

- B. Permanent Lighting: Coordinate installation of permanent lighting prior to commencement of wall tile installation.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient and substrate 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. Source Limitations for Tile: Obtain tile of each type from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
2. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
3. Obtain waterproof membrane and crack isolation membrane, from manufacturer of setting and grouting materials.

- B. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single listed manufacturer:

1. Metal edge strips.

#### 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with grade equal to that of Basis of Design product.

- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

- C. Factory Blending: For tile exhibiting color variations within ranges, 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.

- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

## 2.3 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection as indicated in Section 018113, including the following:
1. Low-Emitting Materials: Adhesives and Sealants: Installation products.
  2. Low-Emitting Materials: Walls: Installation products.

## 2.4 TILE PRODUCTS

- A. Manufacturers / Products:
1. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated on Drawings or comparable products by one of the following, approved by Architect prior to bid:
    - a. American Marazzi Tile, Inc.
    - b. American Olean; a division of Dal-Tile Corporation.
    - c. Crossville, Inc.
    - d. Daltile.
    - e. Interceramic.
    - f. Lone Star Ceramics; Elgin Butler.
    - g. Seneca Tiles, Inc.
- B. Glazed wall tile.
1. Module Size: As scheduled.
  2. Thickness: As scheduled.
  3. Face Size Variation: Rectified.
  4. Face: Plain with modified square edges.
  1. Finish: Match basis of design product.
  2. Tile Color and Pattern: As indicated by manufacturer's designations, or if not indicated, as selected by Architect from manufacturer's full range.
  3. Grout Color: As indicated by manufacturer's designations, or if not indicated, as selected by Architect from manufacturer's full range.
  4. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Indicate proposed trim units on Shop Drawings if trim units are not scheduled.

## 2.5 WATERPROOFING MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. **Fluid-Applied Membrane:** Liquid-latex rubber or elastomeric polymer.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ARDEX Americas; ARDEX 8+9™ Rapid Waterproofing and Crack Isolation Compound.

- b. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane.
- c. Custom Building Products; CBP-9240 Waterproofing & Anti-Fracture Membrane RedGard; SpeedCoat Waterproofing Membrane; RedGard Waterproofing and Crack Prevention Membrane.
- d. H.B. Fuller Construction Products Inc. / TEC; Hydrflex Waterproofing Crack Isolation Membrane.
- e. LATICRETE SUPERCAP, LLC; Laticrete Hydro Ban Waterproofing Crack Isolation Membrane; Laticrete Hydro Barrier Waterproofing Crack Isolation Membrane.
- f. MAPEI Corporation; Mapelastic AquaDefense Waterproofing Crack Isolation Membrane.

## 2.6 SETTING MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ARDEX Americas.
  2. Bonsal American, an Oldcastle company.
  3. Custom Building Products.
  4. H.B. Fuller Construction Products Inc. / TEC.
  5. LATICRETE SUPERCAP, LLC.
  6. MAPEI Corporation.
- B. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
  1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.15.

## 2.7 GROUT MATERIALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. ARDEX Americas.
  2. Bonsal American, an Oldcastle company.
  3. Custom Building Products.
  4. H.B. Fuller Construction Products Inc. / TEC.
  5. LATICRETE SUPERCAP, LLC.
  6. MAPEI Corporation.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.
  1. At Food Service Facilities: Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

## 2.8 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.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
- D. Joint Sealant: Silicone, S, NS, 25, T, NT: Single-component, nonsag or pourable, plus 25 percent and minus 25 percent movement capability, Shore A hardness not less than 35, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade N or P, Class 25, Uses T and NT.

## 2.9 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.

## 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 the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
    - c. Verify that substrate tolerances comply with TCNA allowable variations for the applicable tile types.



3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Permanent Lighting: Proceed with installation of wall tile only once permanent lighting has been installed.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, 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 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors consisting of tiles 8 by 8 inches or larger.
    - c. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. 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.
  2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Glazed Wall Tile: 1/16 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where expansion and isolation joints occur in concrete substrates, locate joints in tile surfaces directly above them.
  2. Where saw-cut crack control joints occur in slabs on ground, relocate joint to nearest tile grout joint using fabric-reinforced, modified-bituminous sheet crack isolation membrane per TCNA F125 Partial.
  3. Provide perimeter expansion joints in tile assemblies in accordance with TCNA Handbook.

### 3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
- B. Extend waterproofing membrane to drain flanges and flashed up perimeter walls and in-field interruptions including columns, chases, and wing walls to form watertight installation.
- C. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

### 3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use

by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

### 3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- 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 protective cleaner from tile surfaces.

### 3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. For tile types and locations, refer to Room Finish Schedule.
- B. Interior Wall Installations, Metal Studs or Furring:
  - 1. Ceramic Tile Wall Installation: TCNA W244C or TCNA W244F; thinset mortar over full waterproofing membrane on cementitious backer units.
    - a. Thinset Mortar: Latex- portland cement mortar.
    - b. Fluid-applied waterproofing membrane.
    - c. Grout: Water-cleanable epoxy grout.
    - d. Application: Porcelain tile or Glazed wall tile: Toilet rooms or showers.
  - 2. Ceramic Tile Wall Installation: TCNA W244C or TCNA W244F; thinset mortar cementitious backer units.
    - a. Ceramic Tile Type: Glazed wall tile.
    - b. Thinset Mortar: Latex- portland cement mortar.
    - c. Grout: Water-cleanable epoxy grout.
    - d. Application: Porcelain tile or Glazed wall tile: Dry area installations.

END OF SECTION

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## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. This Section includes:

1. Acoustical panels.
2. Exposed suspension systems for ceilings.
3. Ceiling-mounted acoustical accessories.

## B. Related Sections includes:

1. Section 095123 "Acoustical Metal Pan Ceilings."

## 1.2 PREINSTALLATION MEETINGS

## A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

## C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of manufacturer's standard size samples of each type, finish, and color.
3. Clips: Full-size hold-down, impact, and seismic clips, if required for Project.

## 1.4 INFORMATIONAL SUBMITTALS

## A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
  - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

- a. Lighting fixtures.
  - b. Diffusers.
  - c. Grilles.
  - d. Speakers.
  - e. Sprinklers.
  - f. Access panels.
  - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
  8. Minimum Drawing Scale: 1/8 inch = 1 foot.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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 a stabilized moisture content.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, 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 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

### 2.3 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection as indicated in Section 018113, including the following:

1. **Low-Emitting Materials: Ceilings.**

- B. Ceiling Attenuation Class (CAC): Not less than that of basis of design product.
- C. Noise Reduction Coefficient (NRC): Not less than that of basis of design product.
- D. Light Reflectance (LR): Not less than that of basis of design product.
- E. Articulation Class (AC): Not less than that of basis of design product.
- F. Antimicrobial Treatment: Not allowed.

### 2.4 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong Ceiling & Wall Solutions.
2. CertainTeed Corporation.
3. Rockfon (Rockwool International).
4. USG Corporation.

### 2.5 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

- B. For acoustical panel types, refer to Finish Legend on Drawings.

1. Edge Detail: Tegular.
2. Edge Detail at Concessions: Square.

### 2.6 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C635/C635M.

- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
  2. Structural Classification: Heavy-duty system where indicated and where recommended by manufacturer for application.
  3. End Condition of Cross Runners: Butt-edge type.
  4. Face Design: Flat, flush.
  5. Cap Material: Aluminum.
  6. Cap Finish: Painted white.
  7. Application: All areas unless otherwise indicated.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System, High Humidity Finish: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G60 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
  2. Structural Classification: Heavy-duty system where indicated and where recommended by manufacturer for application.
  3. End Condition of Cross Runners: Butt-edge type.
  4. Face Design: Flat, flush.
  5. Cap Material: Aluminum.
  6. Cap Finish: Painted white.
  7. Application: Concession, locker room, and other high-humidity locations.

## 2.7 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488/E488M or ASTM E1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled expansion or postinstalled bonded anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B633, Class SC 1 (mild) service condition.
    - c. Corrosion Protection: At high humidity locations: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
  2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190, conducted by a qualified testing and inspecting agency.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:



1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: At high humidity locations: ASTM A 580/A 580M, Type 304, nonmagnetic.
3. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch-diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8-inch-wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

## 2.8 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; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. 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.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## 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. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. 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 unless otherwise indicated and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.
- 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 only 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.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure 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 the structure to which hangers are attached and the 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. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 8. Do not attach hangers to steel deck tabs.
  - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 10. 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.
  - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- 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. Miter corners accurately and connect securely.
  - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. 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 precise fit.
  - 1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  - 3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  - 4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  - 5. 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.

#### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners' level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

#### 3.5 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.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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## SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Steel pans for acoustical metal pan ceiling.
2. Metal suspension system for acoustical, standard-grid metal pan ceilings.

## B. Related Requirements:

1. Section 095113 "Acoustical Panel Ceilings" for ceilings consisting of mineral-base and glass-fiber-base acoustical panels and exposed suspension systems.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product. Include procedure for cutting metal pans.

1. Aluminum pans for acoustical metal pan ceiling.
2. Steel pans for acoustical metal pan ceiling.
3. Stainless steel pans for acoustical metal pan ceiling.
4. Metal suspension system for acoustical, standard-grid metal pan ceilings.
5. Metal suspension system for acoustical, snap-in metal pan ceilings.

## B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:

1. Metal Pans: Set of 6-inch-square Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

## 1.3 INFORMATIONAL SUBMITTALS

## A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
5. Perimeter moldings.

- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical metal pan ceiling suspension system and anchor and fastener type.
- E. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

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

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Metal Pans: Full-size units equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to 2 percent of quantity installed.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E1264 for Class A materials.

#### 2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.

- B. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
- C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
  - 1. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C635/C635M.
    - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A879/A879M, 13Z coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.

## 2.3 STEEL PANS FOR ACOUSTICAL METAL PAN CEILING

- A. Steel Pans for Acoustical Metal Pan Ceiling:
  - 1. Basis of Design: Subject to compliance with requirements, provide Armstrong Metalworks Mesh or comparable products by one of the following:
    - a. Armstrong Ceiling & Wall Solutions.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Lindner Group.
    - d. USG Corporation.
- B. Classification: Units complying with ASTM E1264 for Type XX.
- C. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated and finished to comply with requirements indicated.
  - 1. Torsion-Spring-Hinged Pans: Designed to be securely retained in preslotted, exposed suspension grid by torsion springs provided by manufacturer.
  - 2. Provide penetration for sprinklers where hung below ceiling.
- D. Pan Thickness: Not less than 0.025 inch.
- E. Pan Edge Detail: Square.
- F. Pattern: Woven Wire Mesh, As indicated on Finish Schedule.
- G. Pan Size: 24 by 24 inches and 24 by 72 inches as indicated on Drawings.
- H. Pan Face Finish: as indicated on Finish Schedule.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635/C635M requirements.

- B. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.
- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
- F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.
- G. Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- H. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units unless otherwise indicated.

## 2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL, STANDARD-GRID METAL PAN CEILINGS

- A. Metal Suspension System for Acoustical, Standard-Grid Metal Pan Ceilings:
  - 1. **Manufacturers:** Provide suspension system from same manufacturer as metal pans.
- B. Suspension System: For torsion-spring-hinged pans.
  - 1. Wide-Face, Capped, Double-Web, Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytic zinc-coated or hot-dip galvanized in accordance with ASTM A653/A653M, G30 coating designation, with prefinished, cold-rolled, 15/16-inch-wide, sheet metal caps on flanges.
    - a. Structural Classification: Intermediate-duty system.
    - b. Face Design: Flat, flush.
    - c. Cap Material: Steel cold-rolled sheet.
    - d. Cap Finish: Finished to match color of metal pan.



2. Suspension System for Torsion-Spring-Hinged Metal Pans: Provide runners with factory-cut slots fabricated to accept torsion-spring-hinged attachment.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. **Manufacturers:** Provide edge moldings and trim from same manufacturer as metal pans.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  1. Basis of Design: Armstrong Axxiom trim.
  2. Finish: To match edge molding.

## 2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan 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 metal pan ceilings.
- 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 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

### 3.3 INSTALLATION OF ACOUSTICAL METAL PAN CEILINGS

- A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C636/C636M and manufacturer's written instructions.
- 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 only 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.
  - 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 do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. Secure flat, angle, channel, and rod hangers to ceiling suspension members and 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 the type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  - 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 8. Do not attach hangers to steel deck tabs.
  - 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 10. 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.
  - 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- 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 metal pans.
  - 1. 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.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet. Cut and treat edges to comply with manufacturer's written instructions.
- G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.
  - 1. For torsion-spring-hinged pans, position pans in accordance with manufacturer's written instructions.
  - 2. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
  - 3. Fit adjoining units to form flush, tight joints.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, 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, including dented and bent units.

END OF SECTION

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## SECTION 096253 - SYNTHETIC TURF FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Synthetic grass surfacing.

#### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Synthetic grass surfacing.
- B. Shop Drawings: For synthetic grass surfacing.
  - 1. Include sections and details.
  - 2. Show locations of seams and method of seaming.
- C. Samples: For each type of synthetic grass surfacing indicated.
  - 1. Turf Fabric: 12 inches square.
  - 2. Shock-Attenuation Pad: 12 inches square.
  - 3. Seam Sample: 24 inches square with seam centered in sample.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For synthetic grass surfacing, including maintenance cleaning instructions, to include in maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Turf Fabric: Minimum of 50 sq. ft. for each type indicated.
  - 2. Seaming Tape and Adhesive: One roll of seaming tape and one gallon of adhesive.
  - 3. One new set of maintenance tools of type recommended by synthetic grass surfacing manufacturer for installation.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials in location and manner to allow installation of synthetic grass surfacing without excess disturbance of granular base.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace synthetic grass surfacing that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration and excessive wear.
    - b. Deterioration from UV light.
    - c. Excessive loss of shock attenuation.
    - d. Seam separation, including game lines and markings.
  - 2. Warranty Period: 8 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Turf Fabric: Turf fabric tested in accordance with the following methods, with additional test method conditions for each method in accordance with ASTM F1551.
  - 1. Tuft Bind: Not less than 8 lbf in accordance with ASTM D1335.
  - 2. Breaking Strength: Minimum 250 lbf in warp direction and minimum 250 lbf perpendicular to warp direction, in accordance with ASTM D5034.

## 2.2 SYNTHETIC GRASS SURFACING

- A. Basis of Design: Subject to compliance with requirements, provide RealTurf Multisport artificial turf or comparable products by one of the following:
  - 1. RealTurf.
  - 2. Shaw Sprots Turf.
  - 3. SynLawn.
  - 4. Tarkett Sports.
- B. Turf Fabric: Woven turf fabric with multicolored fiber and UV resistance, complying with the following:
  - 1. Yarn Fiber: Monofilament polyethylene in two shades of green.
  - 2. Gauge: 3/8.
  - 3. Stiches per Sq. Ft.: 2415.
  - 4. Fiber Weight: 70 oz/sq. yd.
  - 5. Total Weight: 105.4 oz/sq. yd.
  - 6. Permeability: 10.2 gpm/sq.ft.

- C. Backing: Manufacturer's standard woven or nonwoven polypropylene primary backing with urethane-coated secondary backing; provide perforations or drainage channels sufficient to meet permeability indicated.
- D. Seam Tape: Synthetic grass manufacturer's recommended seam tape, minimum 12 inches wide.
- E. Cushion:

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine base and other conditions, with Installer present, for compliance with requirements for installation tolerances, permeability, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF SYNTHETIC GRASS SURFACING

- A. Install synthetic grass surfacing in accordance with manufacturer's written recommendations.
- B. Shock-Attenuation Pad Installation: Roll out pad and allow to relax a minimum of six hours prior to final fit and trim. Stagger head seams between adjacent rows. Fit seams snugly without stretching or forcing.
- C. Roll out turf fabric and allow to relax at least four hours prior to seaming.
- D. Provide seams flat and snug, with no gaps or fraying. Remove yarns that are trapped within seams. Attach turf fabric to perimeter restraint system as recommended by the manufacturer.
- E. Repair loose seams and bubbles formed due to expansion of turf fabric prior to installation of infill.

#### 3.3 DEMONSTRATION

- A. Train Owner's maintenance personnel in proper maintenance procedures for synthetic grass surfacing.

END OF SECTION

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## SECTION 096466 - WOOD ATHLETIC FLOORING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Wood athletic flooring.

## B. Related Sections include:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood sleepers.

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for wood athletic flooring.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements in accordance with Section 018113.

## C. Shop Drawings: For each type of floor assembly, include the following:

1. Plans, sections, and attachment details.
2. Locations of different grades of wood flooring.
3. Expansion provisions and trim details.
4. Layout, colors, widths, and dimensions of game lines and markers.
5. Layout, colors, widths, and dimensions of logos.
6. Locations of floor inserts for athletic equipment installed through flooring assembly.

## D. Samples for Initial Selection: For each type of wood athletic flooring and accessory in each type of exposed color and finish.

1. Include manufacturer's color charts showing colors and glosses available for the following:
  - a. Floor finishes.
  - b. Game-line and marker paints.

## E. Samples for Verification: For each type of wood athletic flooring and accessory required; approximately 12 inches long and of same thickness and material indicated for the Work.

1. Include Sample sets showing the full range of normal color and texture variations expected in wood flooring.
2. Include Sample sets showing finishes applied to wood flooring.

## 1.3 CLOSEOUT SUBMITTALS

## A. Maintenance Data: For wood athletic flooring and finish systems to include in maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual that has been approved by MFMA as an accredited Installer according to the MFMA Accreditation Program.
  - 1. Installer responsibilities include installation and field finishing of wood athletic flooring components and accessories, and application of game lines and markers.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver floor assembly materials in unopened cartons or bundles.
- B. Protect wood from exposure to moisture. Do not deliver wood components until after concrete, masonry, plaster, ceramic tile, and similar wet work is complete and dry.
- C. Store wood components in a dry, warm, well-ventilated, weathertight location and in a horizontal position.

## 1.6 COORDINATION

- A. Coordinate flooring manufacturer's recommended flatness tolerances with work of Section 033000 "Cast-in-Place Concrete."
- B. Coordinate layout and installation of slab depressions to accommodate layout and height of wood athletic flooring assembly.
- C. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

## 1.7 FIELD CONDITIONS

- A. Conditioning period begins not less than seven days before wood athletic flooring installation, is continuous through installation, and continues not less than seven days after installation.
  - 1. Environmental Conditioning: Maintain ambient temperature between 65 and 75 deg F and relative humidity planned for building occupants, but not less than 35 percent or more than 50 percent, in spaces to receive wood athletic flooring during the conditioning period.
  - 2. Wood Conditioning: Move wood components into spaces where they will be installed, no later than beginning of the conditioning period.
    - a. Do not install wood athletic flooring until wood components adjust to relative humidity of, and are at same temperature as, spaces where they are to be installed.
    - b. Open sealed packages to allow wood components to acclimatize immediately on moving wood components into spaces in which they will be installed.
- B. After conditioning period, maintain relative humidity and ambient temperature planned for building occupants.
- C. Install wood athletic flooring after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Acer Flooring.
  2. Action Floor Systems, LLC.
  3. Connor Sports.
  4. Horner Sports Flooring.
  5. Robbins Sports Surfaces.

## 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Composite Wood or Agrifiber Products.
  3. Low-Emitting Materials: Flooring.
  4. Low-Emitting Materials: Field applied interior paints and coatings.

## 2.3 SYSTEM DESCRIPTION

- A. System Type: Anchored resilient utilizing manufactured subfloor panels, resilient cushioning, anti-squeak clip and pin anchorage.
- B. Overall System Height: As indicated on Drawings.

## 2.4 PERFORMANCE REQUIREMENTS

- A. Provide wood athletic flooring systems tested by a qualified testing agency according to DIN V 18032-2 and shown to meet the following requirements:
1. Shock Absorption: Minimum 53 percent.
  2. Area of Deflection: Maximum 15 percent.
  3. Vertical Deflection: Minimum 0.09 inch.
  4. Ball Bounce: Minimum 90 percent.
  5. Surface Friction: Not less than 0.4 or more than 0.6.
  6. Rolling Loads: Meet basis of design product performance.

## 2.5 FLOORING MATERIALS

- A. Maple Flooring: Comply with MFMA grading rules for species, grade, and cut.
1. Certification: Provide flooring that carries MFMA mark on each bundle or piece.
- B. Random-Length Strip Flooring: Northern hard maple (*Acer saccharum*), kiln dried, random length, tongue and groove, and end matched.

1. Grade: MFMA-RL Second and Better.
  - a. Exception: For areas under stacked portion of telescoping bleachers that are normally concealed from view, provide Third and Better Grade.
2. Cut: Edge.
3. Thickness: 25/32 inch.
4. Face Width: 2-1/4 inches.

## 2.6 FINISHES

- A. Floor-Finish System: System of compatible components recommended in writing by flooring manufacturer, and MFMA approved.
  1. Floor-Sealer Formulation: Pliable, penetrating type. MFMA Group 1, Sealers.
    - a. Product: Hillyard, 350 Wood Seal.
    - b. Product: Bona Sport, Sport Seal 350.
  2. Finish-Coat Formulation: Formulated for gloss finish indicated and multicoat application.
    - a. Type: MFMA Group 3, Gymnasium-Type Surface Finishes.
    - b. Product: Hillyard, 275 Gym Finish.
    - c. Product: Bona, Bona Sport Poly 275.
  3. Game-Line and Marker Paint: Industrial enamel compatible with finish coats and recommended in writing by manufacturers of finish coats, and paint for this use.

## 2.7 ACCESSORIES

- A. Resilient Wall Base: Molded, vented, rubber or vinyl cove base; 4 by 3 by 48 inches; with premolded outside corners.
  1. Color: Black.
- B. Thresholds: Aluminum, 1/4 by 6 inches, beveled both sides, mill finish.
- C. Fasteners: Type and size recommended by manufacturer, but not less than those recommended by MFMA for application indicated.
- D. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by wood athletic flooring manufacturer.
- E. Adhesives: Manufacturer's standard for application indicated meeting performance requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Comply with wood athletic flooring manufacturer's written instructions, but not less than written recommendations of MFMA applicable to flooring type indicated.
- B. Pattern: Lay flooring parallel with long dimension of space to be floored unless otherwise indicated.
- C. Expansion Spaces: Provide as indicated, but not less than that required by manufacturer's written instructions and MFMA's written recommendations at walls and other obstructions, and at interruptions and terminations of flooring.
  - 1. Cover expansion spaces with base molding, trim, and saddles.
- D. Underlayment: Install perpendicular to direction of flooring, staggering end joints in adjacent rows.
- E. Strip Flooring: Mechanically fasten perpendicular to supports.
- F. Installation Tolerances: 1/8 inch in 10 feet of variance from level.

### 3.4 SANDING AND FINISHING

- A. Allow installed flooring to acclimate to ambient conditions before sanding.
- B. Follow applicable recommendations in MFMA's "Industry Recommendations for Sanding, Sealing, Court Lining, Finishing, and Resurfacing of Maple Gym Floors."
- C. Machine sand with coarse, medium, and fine grades of sandpaper to achieve a level, smooth, uniform surface without ridges or cups. Remove sanding dust by tack or vacuum.
- D. Finish: Apply seal and finish coats of finish system according to finish manufacturer's written instructions. Provide no fewer than four coats total and no fewer than two finish coats.
  - 1. Game-Line and Marker Paint: Apply game-line and marker paint between final seal coat and first finish coat according to paint manufacturer's written instructions.
    - a. Mask flooring at game lines and markers and apply paint to produce lines and markers with sharp edges.
    - b. Where game lines cross, break minor game line at intersection; do not overlap lines.
    - c. Apply game lines and markers in widths and colors according to requirements indicated on Drawings.
    - d. Apply finish coats after game-line and marker paint is fully cured.

### 3.5 PROTECTION

- A. Protect wood athletic flooring during remainder of construction period to allow finish to cure and to ensure that flooring and finish are without damage or deterioration at time of Substantial Completion.
  - 1. Do not cover flooring after finishing until finish reaches full cure and not before seven days after applying last finish coat.
  - 2. Do not move heavy and sharp objects directly over flooring. Protect fully cured floor finishes and surfaces with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Thermoset-rubber base.
  - 2. Rubber molding accessories.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

## 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## 1.4 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.

## 1.5 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Field Paints and Coatings.
  3. Low-Emitting Materials: Flooring.
  4. Certified Flooring Products - SCS Floorscore.

2.2 THERMOSET-RUBBER BASE **RUB-1**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following comparable to scheduled product if any, including scheduled color selections:
1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  2. Flexco.
  3. Johnsonite; a Tarkett company.
  4. Nora, by Interface.
  5. Roppe Corporation, USA.
- B. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
1. Style and Location:
    - a. Style A, Straight: Provide in areas with carpet.
    - b. Style B, Cove: Provide in areas with resilient floor coverings and no floor covering.
- C. Thickness: 0.125 inch.
- D. Height: 4 inches unless otherwise indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated by manufacturer's designations.

## 2.3 RUBBER MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following if providing acceptable match to scheduled products:
1. Armstrong World Industries, Inc.
  2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
  3. Flexco.



4. Nora, by Interface.
  5. Johnsonite; a Tarkett company.
- B. Description: Rubber carpet edge for glue-down applications; nosing for carpet; nosing for resilient floor covering; reducer strip for resilient floor covering; joiner for tile and carpet; transition strips.
- C. Profile and Dimensions: As approved by Architect.
- D. Locations: Provide rubber molding accessories in areas described above subject to approval by Architect.
- E. Colors and Patterns: As indicated by manufacturer's designations.
- 2.4 INSTALLATION MATERIALS
- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type meeting sustainable design requirements, recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Installation of resilient products indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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## SECTION 096519 - RESILIENT TILE FLOORING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Vinyl composition floor tile (VCT).

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of product.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

## D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

## E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

## 1.3 CLOSEOUT SUBMITTALS

## A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

## A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.5 QUALITY ASSURANCE

## A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

- a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile 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 floor tiles on flat surfaces.

#### 1.7 FIELD CONDITIONS

- A. Maintain ambient 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 periods:
  1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

#### 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Flooring.
  3. Certified Flooring Products - SCS Floorscore.

### 2.3 VINYL COMPOSITION FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Armstrong Flooring, Inc.
  - 2. Congoleum Corporation.
  - 3. Tarkett North America.
- B. Tile Standard: ASTM F1066, Class 2, through pattern.
- C. Wearing Surface: Smooth.
- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Colors and Patterns: As indicated by manufacturer's designations.

### 2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Adhesives, High Moisture: Water-resistant high-moisture type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions.
  - 1. Use adhesives approved by tile flooring manufacturer for installation on floor slabs with up to 7 lb. of vapor pressure, relative humidity of up to 90 percent, and pH up to 10.
- D. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer and approved by Owner.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 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 tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.



- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles 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.

#### 3.4 CLEANING OF NEW RESILIENT TILE

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.

#### 3.5 POLISHING AND PROTECTION OF TILE

- A. Floor Polish: Apply three polish coats over sealer coat.
- B. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - 1. Cover floor tile until Substantial Completion.

END OF SECTION

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## SECTION 096566 - RESILIENT ATHLETIC FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Rubber sheet flooring.

#### 1.2 COORDINATION

- A. Coordinate layout and installation of flooring with floor inserts for gymnasium equipment.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

- C. Shop Drawings: Show installation details and locations of the following:

1. Seam locations for sheet flooring.

- D. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch-square in size and of same thickness and material indicated for the Work.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

- B. Store materials to prevent deterioration.

1. Store tiles on flat surfaces.
2. Store rolls upright.

#### 1.6 FIELD CONDITIONS

- A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F or more than 95 deg F.

3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Flooring.
3. Certified Flooring Products - SCS Floorscore.

### 2.2 RUBBER SHEET FLOORING

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acer Flooring, LLC.
2. Action Floor Systems, LLC.
3. Conner Sports Surface Solutions.
4. Horner Flooring Company, Inc.
5. Johnsonite; a Tarkett company.
6. Robbins Sports Surfaces.

B. Description: Rubber athletic flooring provided as rolled goods for adhered installation.

C. Material: Recycled-rubber compound.

D. Traffic-Surface Texture: Smooth.

E. Roll Size: Not less than 48 inches wide by longest length that is practical to minimize splicing during installation.

F. Thickness: 3/8 inch.

G. Color and Pattern: As scheduled on Drawings.

H. ACCESSORIES

I. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

## 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 of the Work.
  - 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of flooring.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Alkalinity Testing: Perform pH testing according to ASTM F710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
  - 3. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.
- E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.
  - 1. Do not install flooring until it is the same temperature as space where it is to be installed.
- F. Sweep and vacuum clean substrates to be covered by flooring 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 FLOORING INSTALLATION, GENERAL

- A. Comply with manufacturer's written installation instructions.

- B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

### 3.4 SHEET FLOORING INSTALLATION

- A. Unroll sheet flooring and allow it to stabilize before cutting and fitting.
- B. Lay out sheet flooring as follows:
  - 1. Maintain uniformity of flooring direction.
  - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
  - 3. Match edges of flooring for color shading at seams.
  - 4. Locate seams according to approved Shop Drawings.
- C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
  - 1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.5 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing flooring installation:
  - 1. Remove adhesive and other blemishes from flooring surfaces.
  - 2. Sweep and vacuum flooring thoroughly.
  - 3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.
- B. Protect flooring 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.
  - 1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION

## SECTION 096723 - RESINOUS FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Resinous flooring.
  - 2. Integral cove base accessories.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Samples for Initial Selection: For each type of exposed finish required.
- D. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

#### 1.5 CLOSEOUT SUBMITTALS

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

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 96-inch-square floor area selected by Architect.
  - a. Include 96-inch length of integral cove base with inside and outside corner.
2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.

#### 2.2 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Field Paints and Coatings.
  3. Low-Emitting Materials: Flooring.
  4. Certified Flooring Products - SCS Floorscore.

#### 2.3 MANUFACTURERS

- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.



## 2.4 RESINOUS FLOORING

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.
1. Manufacturers: Subject to compliance with requirements, provide Key Resin Key Chip Flake #100 or comparable product by one of the following:
    - a. BASF Corporation.
    - b. Key Resin.
    - c. Sherwin-Williams Company, General Polymers.
    - d. Stonhard, Inc.
- B. System Characteristics:
1. Color and Pattern: As indicated on Drawings.
  2. Wearing Surface: Match scheduled product.
  3. Overall System Thickness: Match scheduled product.
- C. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
1. Compressive Strength: 13,000 psi minimum according to ASTM C579.
  2. Tensile Strength: 4200 psi minimum according to ASTM D412.
  3. Flexural Modulus of Elasticity: minimum according to ASTM C580.
  4. Water Absorption: percent maximum according to ASTM C413.
  5. Shrinkage: percent maximum according to ASTM C531.
  6. Indentation: percent maximum according to MIL-D-3134J.
  7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134J.
  8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch according to MIL-D-3134J.
  9. Abrasion Resistance: 32 mg maximum weight loss according to ASTM D4060.
  10. Hardness: 80-85 Shore D according to ASTM D2240.
  11. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.
  12. Slip Resistance: >0.6 per ASTM D2047.
- D. Waterproofing Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.
1. Basis of Design: Key #502.
- E. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.
- F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- G. Body Coats:
1. Basis of Design: Key #515.

2. Resin: Epoxy.
3. Formulation Description: High solids.
4. Type: Pigmented.
5. Application Method: Self-leveling slurry with broadcast aggregates.
6. Number of Coats: Two.
7. Thickness of Coats: 1/8 inch.
8. Aggregates: Vinyl flake.

H. Topcoats: Sealing or finish coats.

1. Basis of Design: Key #510-LV/UV.
2. Resin: Epoxy.
3. Formulation Description: 100 percent solids.
4. Type: Pigmented.
5. Number of Coats: One.
6. Thickness of Coats: 1/8 inch.
7. Finish: Gloss.

I. Colors: Where indicated:

1. Resemble existing terrazzo in flake pattern where indicated.
2. Color and texture as selected by Architect for other areas.

## 2.5 INTEGRAL COVE BASE ACCESSORIES

A. Radius Cove: Cove molding with approximately 1-inch radius for adhesive installation at floor-to-wall joint as substrate to receive resinous flooring system to form an integral cove base.

1. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and 3/4- to 1-inch bullnose outside corners.
2. Cap Strip: Square metal cap provided or approved by flooring manufacturer.

B. Installation Adhesive: As recommended in writing by accessory manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
  - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
  - b. Comply with ASTM C811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
  3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 4.5 lb of water/1000 sq. ft. of slab area in 24 hours.
    - b. Plastic Sheet Test: ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates.
    - c. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
  4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

### 3.2 APPLICATION

- A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Waterproofing Membrane: Apply waterproofing membrane where indicated on Drawings, in manufacturer's recommended thickness.
1. Apply waterproofing membrane to integral cove base substrates.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners.
1. Integral Cove Base: 4 inches high. Where scheduled on Drawings.

- E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.
  - 1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- F. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

### 3.3 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

## SECTION 096813 - TILE CARPETING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Modular carpet tile.

## 1.2 PREINSTALLATION MEETINGS

## A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
  - a. Review delivery, storage, and handling procedures.
  - b. Review ambient conditions and ventilation procedures.
  - c. Review subfloor preparation procedures.

## 1.3 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

## B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

## D. 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 Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

- E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- F. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, 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 tile.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the Carpet and Rug Institute's CRI 104.

#### 1.9 FIELD CONDITIONS

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

## 1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, the following:
    - a. More than 10 percent edge raveling, snags, and runs.
    - b. Dimensional instability.
    - c. Excess static discharge.
    - d. Loss of tuft-bind strength.
    - e. Loss of face fiber.
    - f. Delamination.
  - 3. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  - 1. Low-Emitting Materials: Adhesives and Sealants.
  - 2. Low-Emitting Materials: Flooring.
  - 3. Carpet - CRI Green Label.

2.2 CARPET TILE **CPT-1**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings.
- B. Backing/Backcoating: Manufacturer's standard composite materials comparable to Basis of Design product. PVC-free.
- C. Size: As scheduled.
- D. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment meeting Performance Requirements.
  - 2. Antimicrobial Treatment: Not allowed.
- E. Performance Characteristics: Comparable to Basis of Design product.

## 2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
- C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

### 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 tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - b. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8-inch-wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.



### 3.3 INSTALLATION

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings, or if not indicated, as recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with the Carpet and Rug Institute's CRI 104, Section 13.7.
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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## SECTION 097814 – FRP INTERIOR WALL PANELING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fiberglass reinforced plastic (FRP) sheet paneling.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

C. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

#### 1.3 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

### PART 2 - PRODUCTS

#### 2.1 SUSTAINABILITY REQUIREMENTS

A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:

1. Low-Emitting Materials: Adhesives and Sealants.
2. Low-Emitting Materials: Walls.

#### 2.2 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

#### 2.3 PLASTIC SHEET PANELING **FRP-1**

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Composites, Inc.
  - b. Glasteel.
  - c. Marlite.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 25 or less.
  - b. Smoke-Developed Index: 450 or less.
3. Nominal Thickness: Not less than 0.12 inch.
4. Surface Finish: Smooth.
5. Color: As selected by Architect from manufacturer's full range.

#### 2.4 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  1. Color: Match panels.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- D. Adhesive: As recommended by plastic paneling manufacturer.
- E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.
- B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

- E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels and so that trimmed panels at corners are not less than 12 inches wide.
  - 1. Mark plumb lines on substrate at trim accessory and panel joint locations for accurate installation.
  - 2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.
  - 1. Drill oversized fastener holes in panels and center fasteners in holes.
  - 2. Apply sealant to fastener holes before installing fasteners.
- D. Install trim accessories with adhesive and nails. Do not fasten through panels.
- E. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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## SECTION 098433 - SOUND-ABSORBING WALL UNITS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-absorbing fabric-covered wall panels.
  - 2. Sound-absorbing cementitious wood fiber wall panels.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Shop Drawings: For unit assembly and installation.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at panel head, base, joints, and corners, and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
  - 3. Include details at cutouts and penetrations for other work.
  - 4. Include direction of fabric weave and pattern matching.
- D. Samples for Initial Selection: For each type of fabric facing.
  - 1. Include Samples of hardware and accessories involving color or finish selection.
- E. Samples for Verification: For the following products:
  - 1. Fabric: Full-width by approximately 36-inch-long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch-long Sample(s) showing each edge profile, corner, and finish.
  - 3. Core Material: 12-inch-square Sample at corner.
  - 4. Mounting Devices: Full-size Samples.
  - 5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
  - 2. Items penetrating or covered by units including the following:

- a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  3. Show operation of hinged and sliding components covered by or adjacent to units.
  - B. Sample Warranty: For manufacturer's special warranty.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.
- 1.6 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
    1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
  - B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.
- 1.8 FIELD CONDITIONS
- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - B. Lighting: Do not install units until a lighting level of not less than 50 fc is provided on surfaces to receive the units.
  - C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
  - D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication and indicate them on Shop Drawings.
- 1.9 WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.



1. Failures include, but are not limited to the following:
  - a. Acoustical performance.
  - b. Fabric sagging, distorting, or releasing from panel edge.
  - c. Warping of core.
2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

### 2.3 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Insulation.

### 2.4 SOUND-ABSORBING STRETCHED FABRIC WALL PANELS

- A. Sound-Absorbing Stretched Fabric Wall Panel SWP#1: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.
  - a. Provide [Accutrack, Accusnap](#) Stretched Fabric Panel System.
  2. Mounting: Back mounted with manufacturer's standard framing system, secured to substrate.
- B. Core Materials:

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
- C. Facing Material: As scheduled. Fabric from same dye lot; color and pattern as scheduled as selected by Architect from manufacturer's full range.
  1. Applied Treatments: Stain resistance and flame retardant.
- D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:
  1. Impaling Clips: Manufacturer's standard.
  2. Metal Clips or Bar Hangers: Manufacturer's standard two-part metal "Z" clips, with one part of each clip mechanically attached to back of unit and the other part to substrate, designed to permit unit removal.
- E. Graphics: Provide custom graphic to be issued by Architect.

## 2.5 FABRICATION

- A. Sound-Absorbing Stretched Fabric Wall Panel: Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align fabric pattern and grain with adjacent units unless otherwise indicated on Drawings.

### 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus, or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation of Joint Width: Not more than 1/32-inch variation from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

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## SECTION 099113 - EXTERIOR PAINTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.
- B. Related Requirements:
  - 1. Section 099600 "High-Performance Coatings" for epoxy or polyurethane coatings for scheduled items.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

## 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and Project name.
  - 1. Paint: 1 gal. of each material and color applied.

## 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

## 1.5 FIELD 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 snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); scheduled products, or comparable products by one of the following:
1. Benjamin Moore & Co.
  2. Glidden Professional, Division of PPG Architectural Coatings.
  3. PPG Architectural Coatings.
  4. Pratt & Lambert

## 2.2 PAINT, GENERAL

- A. Material Compatibility:
1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- C. Colors: As indicated in a color schedule.

## 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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
  2. Masonry (Clay and CMUs): 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces 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 hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 3.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

### 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.
  - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed to view:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 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.

### 3.6 EXTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. Water-Based Light Industrial Coating System, Self-Cleaning:
    - a. Prime Coat: S-W LOXON Conditioner.
    - b. Intermediate Coat: Latex, exterior, matching topcoat.



- c. Topcoat: Light industrial coating, exterior, water based, satin: [S-W LOXON Self-Cleaning Acrylic Coating](#), LX 14-50 Series.
- B. CMU Substrates:
1. Water-Based Light Industrial Coating System:
    - a. Block Filler: Block filler, latex, interior/exterior: [S-W PrepRite Block Filler](#), B25W25.
    - b. Intermediate Coat: Latex, exterior, matching topcoat.
    - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss: [S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating](#), B66-1550 Series.
- C. Steel Substrates: Hollow metal doors and frames
1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, alkyd based, anti-corrosive for metal: [S-W Kem Kromik Universal Metal Primer](#), B50AZ6 Series. Field re-prime factory-primed hollow metal doors and frames.
    - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, exterior, water based, semi-gloss: [S-W Pro Industrial Multi-Surface Acrylic Semi-Gloss Coating](#), B66-1550 Series.
    - d. Application: Interior and exterior surfaces of hollow metal doors and frames, and miscellaneous items requiring paint protection.
  2. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items.

END OF SECTION

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## SECTION 099125 - INTERIOR PAINTING AND REPAINTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on new and previously painted interior substrates.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
  - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
  - 3. Section 099600 "High-Performance Coatings" for coating of scheduled items.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps 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: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

## 1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Custodial Maintenance Manual: Provide maintenance manual for Owner's use. Include the following information:
  - 1. Area Summary, an overview of entire project.
  - 2. Area Detail, for each substrate, paint product system, color number and sheen.
  - 3. Product Data Sheet for each product.
  - 4. Safety Data Sheet for each product.
  - 5. Sample of each paint color, minimum of 8 by 8 inches, with manufacturer's designation of color and sheen.
  - 6. Cleaning and touch-up instructions.
  - 7. Contact for local supplier.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents and Project name.
  - 1. Paint: 1 gal. of each material and color applied.

## 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups 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.
    - 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 mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## 1.6 FIELD 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 when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company scheduled products, or comparable products by one of the following:
1. Benjamin Moore & Co.
  2. PPG Architectural Coatings.
  3. Sherwin-Williams Company (The)

## 2.2 PAINT, GENERAL

### A. Material Compatibility:

1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

### B. Colors: As indicated in a color schedule.

### C. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

## 2.3 SUSTAINABLE DESIGN REQUIREMENTS

### A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. **Low-Emitting Materials: Field Paints and Coatings.**

## 2.4 PREPARATORY CLEANING MATERIALS

### A. Water: Potable.

### B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

### C. Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for every 5 gal. of solution required.

### D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.

### E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

### F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

## 2.5 PATCHING MATERIALS

### A. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for filling cementitious substrates and for sanding or tooling prior to repainting; formulation as recommended in writing by manufacturer for type of cementitious substrate indicated, exposure to weather and traffic, the detail of work, and site conditions.

### B. Gypsum-Plaster Patching Compound: Finish coat plaster and bonding compound according to ASTM C842 and manufacturer's written instructions.

## 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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMUs): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

## 3.2 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
  - 1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
  - 2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
  - 3. Neutralize and collect alkaline and acid wastes before disposal.
  - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

## 3.3 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 hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
1. SSPC-SP 3.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Wood Substrates:
1. Scrape and clean knots; and apply coat of knot sealer before applying primer.
  2. Sand surfaces that will be exposed to view; and dust off.
  3. Prime edges, ends, faces, undersides, and backsides of wood.
  4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
- 3.4 MAINTENANCE REPAINTING, GENERAL
- A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at 5 feet away from painted surface away from painted surface.
- B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
1. Remove failed coatings and corrosion and repaint.
  2. Verify that substrate surface conditions are suitable for repainting.
  3. Allow other trades to repair items in place before repainting.

- C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- D. Heat Processes: Do not use torches, heat guns, or heat plates.

### 3.5 PREPARATORY CLEANING OF EXISTING SUBSTRATES

- A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
- B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used, and that surface remains wet. Rinse with water applied by clean rags or sponges.
- C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.
- D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

### 3.6 SUBSTRATE REPAIR

- A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.
- B. Gypsum-Plaster and Gypsum-Board Substrates:
  - 1. Repair defects including dents and chips more than 1/8 inch in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
  - 2. Rout out surface cracks to remove loose, unsound material, fill with patching compound and sand smooth.
- C. Metal Substrate:
  - 1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use chemical or mechanical rust removal method to clean off rust.
  - 2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than 1/16-inch-deep or 1/2 inch across and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
  - 3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.



### 3.7 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms:
    - a. Tanks and other equipment that do not have factory-applied final finishes.
  - 2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards and switchgear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Architect.
  - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.8 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.

### 3.9 INTERIOR PAINTING AND REPAINTING SCHEDULE

- A. Primer Application: Apply at new work, and as recommended by manufacturer at existing surface repainting.
- B. Intermediate Coat: Apply at new work, and as required to achieve uniform cover at existing surface repainting.
- C. Concrete Substrates, Nontraffic Surfaces:
  - 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, alkali resistant, water based.
      - 1) Sherwin-Williams; Loxon concrete & Masonry Primer, A24W8300.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5):
      - 1) Sherwin-Williams; Pro Industrial Pro DTM Acrylic Semi-Gloss A41WQ8051.
- D. Concrete Substrates, Traffic Surfaces:
  - 1. Water-Based Concrete Floor Sealer System:
    - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
    - b. Topcoat: Sealer, water based, for concrete floors.
      - 1) Euclid Chemical; Super Diamond Clear VOX, 359ZZ.
      - 2) PPG Architectural; PPG Paints, Perma-Crete Plex-Seal WB Interior/Exterior Clear Sealer, 4-6200XI Series.
      - 3) Sherwin-Williams; H & C Wet Look Sealer, 50.048054.
    - c. Slip Resistant Additive: S-W Sharkgrip.
- E. CMU Substrates:
  - 1. Water-Based Light Industrial Coating System:
    - a. Block Filler: Block filler, latex, interior/exterior.
      - 1) Sherwin-Williams; Pro Industrial Heavy Duty Block Filler, B42W00150.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

- c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5):
    - 1) Sherwin-Williams; Pro Industrial Pro DTM Acrylic Semi-Gloss A41WQ8051.
  - 2. Water-Based Light Industrial Coating System:
  - 3. Epoxy-Modified Latex System: Toilet Rooms, Janitor Closets, Food Preparation and Servery, and elsewhere where indicated.
    - a. Block Filler: Block filler, latex, interior/exterior.
      - 1) Sherwin-Williams; Pro Industrial Heavy Duty Block Filler, B42W00150.
    - b. Intermediate Coat: Epoxy-modified latex, interior, matching topcoat.
    - c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5).
      - 1) Sherwin-Williams, Pro Industrial, Waterbased Catalyzed Epoxy, B73W311/B73V300.
- F. Steel Substrates:
- 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, rust-inhibitive, water based.
      - 1) Sherwin-Williams; Pro Industrial Pro Cryl Universal Primer, B66W01310.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5).
      - 1) Sherwin-Williams; Pro Industrial Pro DTM Acrylic Semi-Gloss A41WQ8051.
  - 2. High-Performance Coating System: See Section 099600 "High-Performance Coatings" for scheduled items.
- G. Wood Substrates: Wood trim.
- 1. Institutional Low-Odor/VOC Latex System:
    - a.** Prime Coat: Primer, latex, for interior wood.
      - 1) Sherwin-Williams; Multi-Purpose Latex Primer/Sealer, B51W00450.
    - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
    - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
      - 1) Sherwin-Williams; Pro Industrial Acrylic Semi-Gloss Coating B66W00651.
- H. Gypsum Board and Plaster Substrates:
- 1. Institutional Low-Odor/VOC Latex System:

- a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.
    - 1) Sherwin-Williams; ProMar 200 Zero Interior Latex Primer B51W08670.
  - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
  - c. Topcoat, ceilings and soffits: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1).
    - 1) Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Flat, B30W12651.
  - d. Topcoat, walls, unless noted otherwise: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3).
    - 1) Sherwin-Williams; ProMar 200 HP Zero VOC Interior Acrylic Eg-Shel, B20W01661.
  - e. Topcoat, walls, where indicated: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5).
    - 1) Sherwin-Williams; Pro Industrial Acrylic Semi-Gloss Coating B66W00651.
2. Epoxy-Modified Latex System: At toilet rooms and elsewhere where indicated.:
- a. Prime Coat: Primer sealer, latex, interior.
    - 1) Sherwin-Williams; ProMar 200 Zero, Interior Latex Primer, B28W02600/B28WQ2600.
  - b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
  - c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5).
    - 1) Sherwin-Williams, Pro Industrial, Waterbased Catalyzed Epoxy, B73W311/B73V300.

END OF SECTION

## SECTION 099600 - HIGH-PERFORMANCE COATINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes surface preparation and application of high-performance coating systems.
- B. Related Requirements:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 09 painting Sections for special-use coatings and general field painting.

## 1.2 DEFINITIONS

- A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Samples for Verification: For each type of coating system and in 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.
  - 3. VOC content.

## 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated 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 coating system specified in Part 3.
    - a. Wall and Ceiling 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 mockups.
  - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
- 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 COORDINATION

- A. Coordinate selection of topcoats applied over intumescent fireproofing with Work of Section 078123 "Intumescent Fireproofing."

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

#### 1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

### PART 2 - PRODUCTS

#### 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  - 1. **Low-Emitting Materials: Field applied interior paints and coatings.**

#### 2.2 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide scheduled products of Sherwin-Williams Company (The); or a comparable product by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. Corotech Coatings; Benjamin Moore & Co.

3. Tnemec Company, Inc.

## 2.3 HIGH-PERFORMANCE COATINGS, GENERAL

### A. Material Compatibility:

1. Materials for use within each paint system shall be 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, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

### B. Colors: As indicated in color schedule.

## 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 the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry (Clay and CMUs): 12 percent.
  3. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and 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.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
  2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4.
  3. Prepare horizontal traffic surfaces in accordance with coating manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
1. SSPC-SP 7/NACE No. 4, unless otherwise indicated.
  2. SSPC-SP 10/NACE No. 3, for handrails and guardrails.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions.
1. Use applicators and techniques suited for coating and substrate indicated.
  2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.



### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

### 3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Steel Substrates:
  - 1. Pigmented Polyurethane System:
    - a. Application: Exposed exterior steel framing and metal fabrication items and where epoxy paint or high performance coating is indicated.
    - b. Prime Coat: Alkyd anti-corrosive, quick dry: [S-W Kem Kromik Universal Primer, B62WZ111 Series](#), at 3 to 4 mils dry, per coat.
    - c. Intermediate Coat: Polyurethane, two-component, pigmented, matching topcoat.
    - d. Topcoat: Polyurethane, two-component, pigmented, semi-gloss: [S-W Acrolon 218 HS Acrylic Polyurethane, B65-650 Series](#), at 3.0 to 6.0 mils dry, per coat.

### 3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. CMU Substrates:
  - 1. Epoxy System for Wet Environments:
    - a. Block Filler: Block filler, epoxy: SW Protective and Marine, Kem CAT-Coat Epoxy Filler/Sealer, B42W00400 series.
    - b. Intermediate Coat: Epoxy, matching topcoat.
    - c. Topcoat: Epoxy, high build: SW Protective and Marine, Tile-Clad High Solids, B62WZ0111.

B. Gypsum Board Substrates:

1. Epoxy System:

- a. Prime Coat: Primer sealer, latex, interior low-voc: SW ProMar 200 Zero Interior Latex Primer, B28W02600.
- b. Intermediate Coat: Epoxy, matching topcoat.
- c. Topcoat: Epoxy, high build: SW Protective and Marine, Tile-Clad High Solids, B62WZ0111.

C. Steel Substrates:

1. Epoxy System: Water-based Catalyzed Epoxy, LEED v4.1 Emissions and VOC compliant:

a. Application:

- 1) Interior stair components and railing components indicated as painted.

- b. Prime Coat: Primer, rust-inhibitive, water based: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 2.0 to 4.0 mils dry, per coat.
- c. Intermediate Coat: Epoxy, two-component polyamine, pigmented, matching topcoat.
- d. Topcoat: Epoxy, two-component polyamine, semi-gloss: [S-W Pro Industrial Water Based Catalyzed Epoxy, B73-300 Series](#), at 2.0 to 4.9 mils dry, per coat.

END OF SECTION

## SECTION 101100 - VISUAL DISPLAY UNITS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Tackboard assemblies.
  - 2. Markerboard assemblies.

## 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints.
  - 3. Include sections of typical trim members.
  - 4. Size, location, and edge details required for wall mounted play surfaces.
- C. Samples for Verification: For each type of visual display unit indicated.
  - 1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch-long sections of each trim profile.
- D. Product Schedule: For visual display units. Use same designations as indicated on Drawings and specifications.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of tack boards.
- C. Sample Warranties: For special warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display units to include in maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
  - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

## 1.9 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  - 2. Warranty Period: Life of the building.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

## 2.3 VISUAL DISPLAY BOARD ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Claridge Products and Equipment, Inc.
  - 2. Platinum Visual Systems.
  - 3. Forbo Bulletin Board.
  - 4. PolyVision Corporation.
- B. Visual Display Board Assembly: Factory fabricated.
  - 1. Assembly: Marker board.
  - 2. Assembly: Tack board.
  - 3. Corners: Square.
  - 4. Width: As indicated on Drawings.
  - 5. Height: As indicated on Drawings.
  - 6. Mounting Method: Direct to wall.
- C. Aluminum Frames: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
  - 1. Aluminum Finish: Clear anodic finish.
- D. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- E. Combination Assemblies: Provide manufacturer's standard exposed trim between abutting sections of visual display panels.
- F. Marker tray: Manufacturer's standard; continuous.
  - 1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

## 2.4 MARKERBOARD PANELS

- A. Porcelain-Enamel Magnetic Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
  - 1. Face Sheet Thickness: 0.021-inch uncoated base metal thickness.
  - 2. Fiberboard Core: 1/2-inch-thick; with 0.013-inch-thick, galvanized-steel sheet backing.
  - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
  - 4. Marker tray at bottom of panels.

## 2.5 TACKBOARD PANELS

- A. Tackboard Framed Panel: Linoleum.

## 2.6 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Natural-Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish; with surface-burning characteristics indicated.
- C. Linoleum: 1/4-inch thick linoleum sheet over jute backing complying with ASTM F 2034, type 1, class B per ASTM E84.
  - 1. Basis of Design: Forbo Bulletin Board.
  - 2. Color: As indicated on Drawings.
- D. Medium-Density Fiberboard: ANSI A208.2.
- E. Extruded Aluminum: ASTM B 221, Alloy 6063.
- F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application as recommended in writing by visual display unit manufacturer.
- G. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in Section 099123 "Interior Painting" and recommended in writing by visual display unit manufacturer for intended substrate.

## 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 unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.

- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and direct-applied floor-to-ceiling visual display assemblies and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Prepare recesses for sliding visual display units as required by type and size of unit.

### 3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and accessories indicated. Join parts with a neat, precision fit.
  - 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
  - 2. Where size of visual display board assemblies or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- D. Visual Display Board Assembly Mounting Heights: Install visual display units at mounting heights indicated on Drawings

### 3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.

- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION



## SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
1. Cast dimensional characters for exterior.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter signs.
1. Include fabrication and installation details and attachments to other work.
  2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  3. Show message list, typestyles, graphic elements, and layout for each sign.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
1. Dimensional Characters: Half-size Sample of each type of dimensional character.
  2. Exposed Accessories: Full-size Sample of each accessory type.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

## PART 2 - PRODUCTS

## 2.1 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. [A.R.K. Ramos.](#)
    - b. [ASI Sign Systems, Inc.](#)
    - c. [Gemini Incorporated.](#)
    - d. [Metal Arts.](#)
    - e. [Southwell Company \(The\).](#)
  2. Character Material: Sheet or plate aluminum.
  3. Character Height: As indicated on Drawings.
  4. Thickness: Manufacturer's standard for size of character but not less than 0.25 inch.
  5. Finishes:

- a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

## 2.2 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

## 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
  1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
  2. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
  3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

## 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
  4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

## 2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## 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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

## SECTION 101423 – PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Panel signs and room-identification signs to the extent required by authorities having jurisdiction.

B. Related Information:

1. All other panel signs and room-identification signs are Owner Furnished / Owner Installed.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.
2. Room-Identification Signs: Full-size Sample.

E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

#### 2.2 SIGNS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASI Sign Systems, Inc.
  2. Best Sign Systems, Inc.
  3. InPro Corporation (IPC).
  4. Mohawk Sign Systems.
  5. Nelson-Harkins Industries.
- B. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Laminated-Sheet Signs and Room Identification Signs: Photopolymer face sheet with raised graphics laminated to acrylic backing sheet at interior and fiberglass sheet at exterior, to produce composite sheet.
    - a. Composite-Sheet Thickness: 0.25 inch.
    - b. Surface-Applied Graphics: Applied paint.
  2. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition, Vertical Edges, Horizontal Edges: Square cut.
    - b. Corner Condition in Elevation: Square.
  3. Mounting: Adhesive.
  4. Surface Finish and Applied Graphics:
    - a. Integral Acrylic and Fiberglass Sheet Colors: As selected by Architect from full range of industry colors.
    - b. Painted Finish and Graphics: Manufacturer's standard, factory-applied acrylic polyurethane, in color as selected by Architect from manufacturer's full range.
    - c. Overcoat: Manufacturer's standard baked-on clear coating.
  5. Text and Typeface: Accessible raised characters and Braille typeface as indicated on Drawings and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.
- C. Tactile and Braille Sign: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks, Braille dots with domed or rounded shape.
- D. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.
1. Furnish insert material and software for creating text and symbols for PC-Windows computers for Owner production of paper inserts.
  2. Furnish insert material cut-to-size for changeable message insert.
- 2.3 PANEL-SIGN MATERIALS
- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

- B. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

#### 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
- B. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
  - 1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Furnish two blank inserts for each sign for Owner's use.

#### 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

### 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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated or as directed by Architect.
- C. Mounting Methods:
  - 1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

### 3.4 SIGNAGE SCHEDULE

- A. Panel Sign Requirements, General:
  - 1. Changeable Message Insert Signs: For Fire Evacuation Route signage.
- B. Special Panel Sign Requirements: Signage required by authorities having jurisdiction, whether or not indicated. Below are examples only; verify code requirements with Architect:
  - 1. Fire Code Signage:
    - a. Fire Sprinkler Riser Room.
    - b. FACP (Fire Alarm Control Panel).
    - c. Main Electrical Room.



- d. Roof Access.
- e. Assembly space capacities
- f. First Responder door identification.
- g. Fire Evacuation Route.
- h. Exterior fire department connection sign.

END OF SECTION

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## SECTION 102113 - PHENOLIC-CORE TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

##### B. Related Requirements:

1. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

##### B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.

##### C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

##### D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

##### E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

#### 1.3 INFORMATIONAL SUBMITTALS

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Maintenance Data: For toilet compartments to include in maintenance manuals.

## 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

## 2.2 PHENOLIC-CORE TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bobrick Washroom Equipment, Inc.
  - 2. Bradley Corporation.
  - 3. Columbia Lockers; Partition Systems International of South Carolina.
  - 4. General Partitions Mfg. Corp.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.
  - 1. Panel Size: Standard or custom, as indicated on Drawings.
- E. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- F. Brackets (Fittings):
  - 1. Continuous Type: Stainless steel.
- G. Phenolic-Panel Finish:
  - 1. Facing Sheet Finish: One color and pattern in each room.
  - 2. Color and Pattern: As selected by Architect from manufacturer's full range of standard colors.

3. Edge Color: Black.

## 2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless-steel continuous, cam type that swings to a closed or partially open position, allowing emergency access by lifting door. Mount with through-bolts.
2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors. Mount with through-bolts.
5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Extrusions: ASTM B 221.
- B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless-Steel Castings: ASTM A 743/A 743M.

## 2.5 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Continuous Brackets: Secure panels to walls and to pilasters.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

## 3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION

## SECTION 102239 - FOLDING GLASS-PANEL PARTITIONS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes manually operated, glass-panel partitions.
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For operable glass-panel partitions.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
- C. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
  - 1. Panel Edge Material: Not less than 3 inches long.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Test Reports: From qualified independent testing agency, indicating product compliance with performance requirements.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For qualified Installer.
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's special warranty.

## 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable glass-panel partitions to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Panel finish and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
- b. Seals, hardware, track, track switches, carriers, and other operating components.
- c. Electric operator and controls.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable glass-panel partitions that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Faulty operation of operable glass-panel partitions.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
  2. Warranty Period: Two years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

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

### 2.2 OPERABLE GLASS PANELS

- A. Operable Glass Panels: Aluminum-framed glass-panel partition system, including panels, seals suspension system, operators, and accessories.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Solar Innovations Series Si300 Folding Glass Wall System, C2 non-thermal system, or a comparable product by one of the following:
    - a. DORMA USA, Inc.
    - b. Nana Wall Systems, Inc.
    - c. Modernfoli
- B. Panel Operation: Manually operated, continuous hinged panels, with integral swing door. Panels shall be top supported, with top and bottom seals.



- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
1. Factory-Glazed Fabrication: Glaze operable glass panels in the factory where practical and possible for applications indicated. Comply with manufacturer's written instructions and with requirements in Section 088000 "Glazing."
- D. Swing Doors: Aluminum-framed glazed panel, installed as swing door, hinged to other glazed panel or wall, matching panel materials, construction, acoustical qualities, finish and thickness, complete with operating hardware. Hinges finished to match other exposed hardware.
1. Accessibility Standard: Fabricate doors to comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
  2. Hardware: Equip door with the following:
    - a. Door Seals: Jamb and head compression seals; automatic drop bottom floor seals.
    - b. Concealed door closer.
    - c. Lock: Key-operated lock with cylinder, keyed to master key system, operable from both sides of door. Include two keys per lock.
- E. Glass and Glazing: As follows:
1. Safety Glass Standard for Partition Panels and Pass Doors: Glass products complying with testing requirements in 16 CFR 1201, Category II.
  2. Glass: Manufacturer's standard safety glass and glass assemblies as indicated and complying with requirements in Section 088000 "Glazing" and as follows:
    - a. Tempered Glass: ASTM C1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear), Quality-Q3.
    - b. Glass Thickness: Manufacturer's standard for size and weight of panels, but not less than 3/8 inch.
  3. Glazing System: Manufacturer's standard factory-glazing system that produces acoustical seal.
- F. Dimensions: Fabricate operable glass-panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
1. Panel Width: Equal widths.
- G. Panel Frame Materials:
1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
    - a. Frame Reinforcement: Manufacturer's standard steel or aluminum.

- H. Panel Closure: Manufacturer's standard for acoustical rating indicated unless otherwise indicated.
- I. Hardware: Manufacturer's standard as required to operate operable glass-panel partition, swing door and accessories; with decorative, protective finish. Style and finish shall be selected from manufacturer's full range.
  - 1. Hinges: Manufacturer's standard.
  - 2. Pulls:
  - 3. Handles.
- J. Panel Frame Finishes:
  - 1. Exposed Metal: as follows:
    - a. Aluminum: Clear anodized.

### 2.3 SEALS

- A. Description: Seals that produce operable glass-panel partitions complying with performance requirements and the following:
  - 1. Manufacturer's standard acoustical seals.
  - 2. Seals made from materials and in profiles that minimize sound leakage.
  - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable glass-panel partition perimeter and adjacent surfaces, when operable glass-panel partition is extended and closed.

### 2.4 SUSPENSION SYSTEMS

- A. Tracks: Steel or aluminum mounted directly to overhead structural support, designed for operation, size, and weight of operable glass-panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable glass-panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
- C. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.
- D. Steel Finish: Manufacturer's standard, factory-applied, corrosion-resistant, protective coating unless otherwise indicated.
- E. Bottom Track: Recessed.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine flooring, floor levelness, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable glass-panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Install operable glass-panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- B. Install panels in numbered sequence indicated on Shop Drawings.
- C. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- D. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.
- E. Light-Leakage Test: Temporarily opacify glass areas of panels. Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

## 3.3 ADJUSTING

- A. Adjust operable glass-panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust pass doors to operate smoothly and easily, without binding or warping.
- C. Verify that safety devices are properly functioning.

## 3.4 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

## 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable glass-panel partitions.

END OF SECTION

## SECTION 102600 - WALL AND DOOR PROTECTION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Surface-mounted plastic cover corner guards.
  - 2. Metal corner guards.

## 1.2 ACTION SUBMITTALS

- A. Samples for Verification: For each type of exposed finish required.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain wall protection units from single source from single manufacturer.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113 "Sustainable Design Requirements," including the following:
  - 1. **Low-Emitting Materials: Adhesives and Sealants.**

## 2.2 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
  - 1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Construction Specialties, Inc.](#), [Acrovyn Corner Guards SSM-20N/SSM-25N](#), or a comparable products by one of the following:
    - a. [Inpro Corporation](#).
    - b. Alpar.
    - c. C S Specialities.
  - 2. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness as follows:
    - a. Profile: Nominal 2-inch-long leg and 1/4-inch corner radius.
    - b. Color and Texture: As scheduled, or if not scheduled, as selected by Architect from manufacturer's full range.

3. Continuous Retainer: Minimum 0.060-inch-thick, one-piece, extruded aluminum.
  4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
  5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
  6. Application: Provide where indicated on Drawings.
  7. Mounting: At top of resilient wall base and extend to height of tops of adjacent door frames, approximately 7-foot 2 inch.
- B. Surface-Mounted, Metal Corner Guards: Fabricated from one-piece, formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
1. **Basis-of-Design Product:** Subject to compliance with requirements, provide [Construction Specialties, Inc.](#), [Heavy Duty Corner Guards CO-8](#), or a comparable products by one of the following:
    - a. [Inpro Corporation](#).
    - b. [Korogard Wall Protection Systems; a division of RJF International Corporation](#).
    - c. [Nystrom](#).
  2. Material: Stainless steel, Type 304.
    - a. Thickness: Minimum 0.0625 inch.
    - b. Finish: Directional satin, No. 4.
  3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
  4. Wing Size: At Partition End: Nominal 2-1/2 by 2-1/2 inches by partition width.
  5. Corner Radius: 1/8 inch.
  6. Mounting: Adhesive.
  7. Application: Provide where indicated on Drawings.
  8. Mounting: At top of resilient wall base and extend to height of tops of adjacent door frames, approximately 7-foot 2 inch.

## 2.3 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required; thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive Tape: Product: [3M Adhesive Transfer Tape 9473PC](#), unless other product is recommended by protection product manufacturer.

## 2.4 FABRICATION

- A. Fabricate components with tight seams and joints with exposed edges eased. Provide surfaces and edges free of wrinkles, chips, dents, uneven coloration, burrs, sharp edges, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

#### 3.3 INSTALLATION

- A. General: Install wall protection units' level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  - 1. Install wall protection units in locations and at mounting heights indicated on Drawings or, if not indicated, as indicated below:
  - 2. Provide splices, adhesive tapes, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.
- B. Installation of Metal Corner Guards: Install at locations indicated on Drawings, or if not indicated, at outside corners of gypsum board.
  - 1. Install using specified adhesive mounting tape.

#### 3.4 CLEANING

- A. Immediately after completion of installation, wall protection units using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes the following, where scheduled:

1. Public-use washroom accessories.
2. Underlavatory guards.
3. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.

#### 1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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

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

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

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

#### 1.4 INFORMATIONAL SUBMITTALS

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

#### 1.5 CLOSEOUT SUBMITTALS

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



## 1.6 WARRANTY

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

## PART 2 - PRODUCTS

## 2.1 ACCESSORIES

- A. Source Limitations: Obtain accessories from single source from single manufacturer.
- B. Provide accessories as scheduled on Drawings or comparable products by one of the following:
  - 1. Bobrick.
  - 2. Bradley.
- C. Owner-Furnished Materials: As scheduled on Drawings.

## 2.2 PERFORMANCE REQUIREMENTS

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

## 2.3 WARM-AIR DRYERS

- A. Source Limitations: Obtain warm-air dryers from single source from single manufacturer.
- B. High-Speed Warm-Air Dryer:
  - 1. **Basis** of Design: Subject to compliance with requirements, provide Bradley 2923-287401 Aerix + High Speed dryer or comparable product by one of the following:
    - a. Bradley.
    - b. Excel.
    - c. Dyson.
    - d. World Dryer.
  - 2. Description: High-speed, warm-air hand dryer for rapid hand drying.
  - 3. Mounting: Surface mounted, with low-profile design, ADA compliant.
  - 4. Operation: Electronic-sensor activated with operation time of 10 to 20 seconds.
  - 5. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  - 6. Discharge Temperature: 130 degrees F at 4 inches.
  - 7. Air Speed: 13,200 to 19,800 lfm.
  - 8. Effective Airflow: 42-64 cfm.
  - 9. Noise Level: 69 dB.
  - 10. Electrical Requirements: 115 V, 15 A, 1725 W.

## 2.4 UNDERLAVATORY GUARDS

### A. Underlavatory Guard

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

### B. Products: Subject to compliance with requirements, provide one of the following:

1. Plumberex Specialty Products, Inc.; PRO-EXTREME.
2. Truebro by IPS Corporation; Lav Guard 2.

## 2.5 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B19, flat products; ASTM B16/B16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B30, castings.
- C. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- F. 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.
- G. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.6 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 PREPARATION

- A. Confirm location of accessories and provide sufficient blocking to anchor accessories securely in place. Where indicated, also provide blocking for future installation of accessories.

### 3.2 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 ASTM F446.

### 3.3 ADJUSTING AND CLEANING

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

END OF SECTION

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:
  - a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semi-recessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on samples 6 by 6 inches square.

D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semi-recessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

#### 1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

#### 1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers fire hoses, hose valves, and hose racks indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.3 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher and hose valve.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Guardian Fire Equipment, Inc.
    - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - c. Larsens Manufacturing Company.
    - d. Nystrom.
    - e. Potter Roemer LLC; a Division of Morris Group International.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Semi-recessed Cabinet: Where recessed cabinet is not compatible with wall construction: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
- E. Surface-Mounted Cabinet, where indicated: Cabinet box fully exposed and mounted directly on wall with no trim.
- F. Cabinet Trim Material: Steel sheet.
- G. Door Material: Steel sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. 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 manufacturer's standard hinge, permitting door to open 180 degrees.

K. 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 indicated.
  - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
    - 1) Location: Applied to cabinet door.
    - 2) Application Process: Silk-screened.
    - 3) Lettering Color: Red.
    - 4) Orientation: Vertical.

L. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
  - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
  - b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - c. Color: As selected by Architect from manufacturer's full range.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.4 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. Miter corners and grind smooth.
  3. Provide factory-drilled mounting holes.
  4. Prepare doors and frames to receive locks.
  5. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
  2. Fabricate door frames of one-piece construction with edges flanged.
  3. Miter and weld perimeter door frames and grind smooth.

- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.
- B. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare recesses for recessed and semi-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 acceptable to authorities having jurisdiction.
- B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
  - 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semi-recessed fire-protection cabinets.
  - 2. Provide inside latch and lock for break-glass panels.
  - 3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

### 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. Touch up marred finishes or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.
- E. 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



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## SECTION 104416 - FIRE EXTINGUISHERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

## 1.2 ACTION 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.
- B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

## 1.3 CLOSEOUT SUBMITTALS

- A. 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 FMG.

## 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 indicated and where bracket-mounted fire extinguisher is indicated.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Babcock-Davis.
  - 2. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - 3. Larsens Manufacturing Company.
  - 4. Nystrom, Inc.
  - 5. Potter Roemer LLC.

- C. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- D. Multipurpose Dry-Chemical Type in Steel Container FE: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
  - 1. Application: All locations unless otherwise indicated.

### 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 in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

## SECTION 105100 - LOCKERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes.
  - 1. Phenolic lockers.
  - 2. Wood benches.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of phenolic locker and bench.
- B. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for recycled content.>](#)
  - 2. [<Double click to insert sustainable design text for EPDs and HPDs.>](#)
  - 3. [<Double click to insert sustainable design text for regional materials.>](#)
  - 4. [<Double click to insert sustainable design text for certified phenolic.>](#)
  - 5. [<Double click to insert sustainable design text for certified phenolic.>](#)
  - 6. [<Double click to insert sustainable design text for composite phenolic.>](#)
  - 7. [<Double click to insert sustainable design text for adhesives.>](#)
- C. Shop Drawings: For phenolic lockers.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show details full size.
  - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 4. Show locations and sizes of cutouts and holes for items installed in lockers.
  - 5. Show locker fillers, trim, base, sloping tops, and accessories.
  - 6. Show locker identification system and numbering sequence.
- D. Samples: For the following products:
  - 1. Each type of material, color, and finish required for lockers and benches, prepared on 6-inch-square Samples of same thickness and material indicated for the Work.
  - 2. Each type of hardware and accessory.

## 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For adjusting and repairing, doors and latching mechanisms to include in maintenance manuals.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Units of the following locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:
    - a. Hinges.
    - b. Pulls.
    - c. Blank identification plates and holders.
    - d. Hooks.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location.
- B. Deliver master and control keys to Owner by registered mail or overnight package service.

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
  - 1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed and indicate measurements on Shop Drawings.
- B. Established Dimensions: Where phenolic lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. 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 concealed phenolic support bases.
  - 1. Requirements are specified in Section 061053 "Miscellaneous Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that phenolic lockers can be supported and installed as indicated.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Structural failures.
  - b. Faulty operation of locks and other hardware.
  - c. Deterioration of phenolic, phenolic finishes, and other materials beyond normal use.
  - d. **<Insert failure modes>**.
2. Warranty Period: [**Three**] **<Insert number>** years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: [**25**] [**75**] [**200**] or less.
  2. Smoke-Developed Index: 450 or less.
- B. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in [the USDOJ's "2010 ADA Standards for Accessible Design"] [the ABA standards of the Federal agency having jurisdiction] [and] [ICC A117.1] **<Insert requirement>**.

### 2.2 PHENOLIC LOCKERS

- A. Basis of Design: Subject to compliance with requirements, provide Holman Model Z type double tier lockers or comparable products by one of the following:
1. ASI Storage Solutions.
  2. General Partitions Manufacturing Corp.
  3. Holman.
  4. Partitions Systems of South Carolina.
  5. Summit Lockers.
- B. Locker Body: Fabricated from phenolic-core panels, 5/8-inch thick.
- C. Flush, Solid-Phenolic Doors: 1/2-inch-thick, solid phenolic; panel.
- D. End Panels: Match style, material, construction, and finish of phenolic doors.
- E. Shelves: 5/8-inch thick phenolic panels.
- F. Continuous Finish Base: Phenolic-faced, 3/4-inch-thick panel that matches door faces; fabricated in lengths as long as practical to enclose base and base ends of lockers.
- G. Valence: Phenolic panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical.

## 2.3 MATERIALS

- A. Panel Construction: Solid phenolic-core panel material with melamine facing on both sides fused together during panel manufacture (not separately laminated) and with eased and polished edges.
- B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- C. Stainless Steel Castings: ASTM A743/A743M.
- D. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- E. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

## 2.4 HARDWARE

- A. Digital Keypad Lock: Keypad with reprogrammable manager and owner codes that override access. Three consecutive incorrect code entries shall disable lock for three minutes.
  - 1. Designed for shared or temporary access by multiple users, with user-defined code to lock and unlock. Provide LED indicator to show when lock is in use.
- B. Frameless Hinges (European Type): Fully concealed, self-closing, nickel-plated steel, with not less than 125 degrees of opening.
  - 1. Provide two hinges for doors [**36 inches**] [**42 inches**] high and less.
  - 2. Provide three hinges for doors more than [**36 inches**] [**42 inches**] high.
- C. Hooks: Manufacturer's standard, ball-pointed stainless steel; Attach hooks with at least two fasteners.
  - 1. Provide one single-prong wall hook for each compartment of single-tier double-tier lockers.
- D. Coat Rods: 3/4-inch-diameter stainless steel rod.
  - 1. Provide coat rod for each compartment of double-tier lockers.

## 2.5 ACCESSORIES

- A. Number Identification Plates: 1-1/2-inch-diameter, etched, embossed, or stamped, aluminum plates with black numbers and letters at least 1/2 inch high. Identify lockers in sequence indicated on Drawings.

## 2.6 BENCHES

- A. Basis of Design: Subject to compliance with requirements, provide Holman traditional locker benches.

- B. End-Panel Locker Benches: Bench top supported between vertical end supports, as follows:
1. End Supports: 3-inch thickness, with height and width same as height and width of bench.
    - a. Finish: As selected from manufacturer's standard options.
  2. Bench Top: 3-inch-thick, particleboard core. Provide 1/2-inch-radius top edges on bench sides.
    - a. Width: 15 inches except provide minimum 20-inch width where accessible benches are indicated.
    - b. Height: 18 inches measured from top of bench to floor.
    - c. Length: As indicated.
    - d. Finish: As selected from manufacturer's standard options.
  3. [Bench Backs: Back support for full width of bench, secured to bench.
    - a. Construction: Match style, material, and finish of bench top:
    - b. Height: Beginning at a point no more than 2 inches above the seat surface to a height no less than 18 inches above the seat surface.]

## 2.7 FABRICATION

- A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.
1. Fabricate lockers to dimensions, profiles, and details indicated.
  2. Ease edges of corners of solid-phenolic members to 1/16-inch radius.
- B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.
1. Fabricate lockers using manufacturer's standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.
  2. Fabricate lockers with joints that are dadoed or rabbeted, glued full length, and stapled. Dado side panels to receive shelving except where indicated to be adjustable.
- C. Accessible Lockers: Fabricate as follows:
1. Locate bottom shelf no lower than 15 inches above the floor.
  2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- D. Number Identification Plates: Inlay number plates flush in each locker door, near top, centered.
- E. Complete fabrication, including assembly, finishing, 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.



1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that the parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
  2. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.
- F. Shop cut openings, to maximum extent possible, to receive hardware 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.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Condition lockers to average prevailing humidity conditions in installation areas before installation.
- B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

#### 3.3 INSTALLATION

- A. Install wood support base with 1/2-inch-thick, phenolic top.
- B. Install lockers level, plumb, and true; use concealed shims.
- C. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.
- D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
  1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
  2. Maintain veneer sequence matching of phenolic-faced phenolic lockers.
- E. Install number identification plates after lockers are in place.
  1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.

- F. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

#### 3.4 ADJUSTING

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding. Verify that integral locking devices operate properly.

#### 3.5 PROTECTION

- A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

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## SECTION 107119 – FLOOD BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Flood barriers.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Flood Barrier

B. Shop Drawings:

1. Fabrication details and dimensions.
2. Plan, section, elevation.

- C. Delegated-Design Submittal: For flood barriers, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Qualifications.

- B. Installation Instructions:

- C. Qualification Data:

1. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the state in which Project is located.

- D. Product Test Reports: For flood barriers, for tests performed by manufacturer and witnessed by a qualified testing agency.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: A specialty firm with a minimum of five years' experience in the manufacturer and installation of flood barriers with a record of successful installation.

#### 1.6 COORDINATION

#### 1.7 WARRANTY

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Flood Barriers shall comply with FEMA 3-21, FEMA 102 and FEMA P-936 for dry flood proofing.
- B. Structural Loads: Design flood barriers for the loads and load combinations per ASCE-7, Section 2.0, including the following:
  - 1. Hydrostatic Pressure: based on water moving at less than 8 feet/sec per ASCE-14 Section 6.2.1 and ASCE 7-16 Section 5.3.3.2 and C5.3.3.2 at design depth indicated on Drawings.
  - 2. Wind Loads: As indicated on Drawings.

## 2.2 FLOOD BARRIERS

- A. Removable flood barriers: Removable barriers with side extension and inflatable gaskets designed to be installed in door or window jamb without additional hardware permanent channels or receptors on building.
- B. Basis of Design: Subject to compliance with requirements, provide model Dam Easy Flood Barrier Door Dam or comparable products by one of the following.
  - 1. Dam Easy, a division of All Weather Industries, distributed in the US by Floodproofing.com.
  - 2. Presray Corporation.
  - 3. Walz & Krenzer.
- C. Compression Seal: EPDM 40-50, Shore A, with pneumatic inflatable seal.
- D. Extension Poles: Provide extension poles for opening larger than standard panel sizes. Cap cover for hole when barrier not in use.

## 2.3 MATERIALS

- A. Main Body: ABS2100 – GR10 Glass Fibre Reinforcement
- B. Inner Mouldings: POM M90-44 Polyacetal
- C. Reinforcement: Stainless Steel 304
- D. Gear System: Brass
- E. Pneumatic Parts: Supplied by Festo German

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. For extension poles, core drill slab and install anchor rod.
- B. Install flood barriers where indicated, level and plumb in accordance with manufacturer's written recommendations and approved Shop Drawings. Inflate seals and test for water tightness.
- C. After inspection deflate seals, remove extension poles and package flood barriers for on-site storage. Label barriers for intended location and store as directed by Owner or Architect.

END OF SECTION

## SECTION 113013 - RESIDENTIAL APPLIANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section includes the installation of the following Owner-furnished equipment:

1. Clothes Washers
2. Clothes Dryers

B. Related Sections Include:

1. Division 23 Sections for ventilation of clothes dryers.

#### 1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data: Owner will provide for each type of product.

1. Installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Product Schedule: For appliances. Use same designations indicated on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranties: For manufacturers' special warranties.

#### 1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each appliance to include in operation and maintenance manuals.

#### 1.6 WARRANTY

A. Convey manufacturers' special warranties to Owner.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 LAUNDRY APPLIANCES

- A. Owner will provide laundry appliances as shown on the Drawings.

## 2.3 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Coordinate roughing-in for ventilation systems to verify actual locations of duct connections before appliance installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.



3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

#### 3.4 DEMONSTRATION

- A. Owner shall engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION

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## SECTION 116623 - GYMNASIUM EQUIPMENT

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes the following gymnasium equipment:

- 1. Basketball equipment.
- 2. Volleyball equipment.
- 3. Safety pads.

## 1.3 DEFINITIONS

- A. NFHS: The National Federation of State High School Associations.

## 1.4 ACTION SUBMITTALS

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

- 1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.
- 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

- B. LEED Submittals:

- 1. Laboratory Test Reports for Credit IEQ 4: For composite wood products, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Shop Drawings: For gymnasium equipment. Include plans, elevations, sections, details, attachments to other work, and the following:

- 1. Miscellaneous framing required for support of gymnasium equipment provided under work of this Section in addition to structural members indicated.
- 2. Method of field assembly for removable equipment, connections, installation details, mountings, floor inserts, attachments to other work, and operational clearances.
- 3. Transport and storage accessories for removable equipment.

- D. Samples for Initial Selection: For each type of gymnasium equipment indicated.

- E. Samples for Verification: For the following products:

- 1. Pad Fabric: Not less than 3 inches square, with specified treatments applied. Mark face of material.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, point reactions, and locations for attachment of gymnasium equipment to structure.
- B. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finished flooring.
- C. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.
- D. Qualification Data: For professional engineer.
- E. Warranty: Special warranty specified in this Section.

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.
- 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.

### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, 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.
- B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

### 1.9 COORDINATION

- A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.
- B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

### 1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Basketball backboard failures including glass breakage.
    - b. Faulty operation of motorized equipment and controls.
  2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 BASKETBALL EQUIPMENT

- A. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
1. Draper Inc.
  2. Performance Sports Systems.
  3. Porter Athletic Equipment Company.
- B. General: Provide equipment complying with requirements in NFHS's "NFHS Basketball Rule Book."
- C. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
- D. Overhead-Supported Backstop:
1. Folding Type: Provide manufacturer's standard assembly for forward-folding, rear-braced backstop, with hardware and fittings to permit folding.
  2. Framing: Steel pipe, tubing, and shapes. Design framing to minimize vibration during play. Provide secondary framing required in addition to structural members indicated.
    - a. Center-Mast Frame: Welded with side sway bracing.
    - b. Finish: Powder-coat finish.
      - 1) Color: White.
  3. Goal Height Adjuster: Adjustable from 8 to 10 feet with gear-drive mechanism, locking in any position within adjustment range, with visible height scale attached to side of framing.
    - a. Electric Operator: Cordless reversible electric operator for use with manual height adjuster.
- E. Backstop Safety Device: Designed to limit free fall if support cable, support chain, pulleys, fittings, winch, or related components fail; with mechanical automatic reset; 6000-lb load capacity; one per folding backstop.

1. Retractor Device: Manufacturer's standard device designed to retract both support and safety cables, chains, and straps away from play of the basketball when backstop is in playing position; one per folding backstop.
- F. Backstop Electric Operator: Provide operating machine of size and capacity recommended by manufacturer for equipment specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, and remote controls. Coordinate wiring requirements and electrical characteristics with building electrical system.
1. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.
  2. Operator Mounting: Wall-mounting board.
  3. Motor Characteristics: Sufficient to start, accelerate, reverse, and operate connected loads at designated speeds within installed environment and with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1, and the following:
  4. Voltage: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
  5. Horsepower: 3/4 hp minimum.
  6. Enclosure: Manufacturer's standard.
  7. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
  8. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
  9. Phase: One.
  10. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop basketball equipment at fully retracted and fully lowered positions.
- G. Remote-Control Station: For group control of basketball backstops with electric winches and electric divider curtains, gym lighting, and bleachers.
1. Basis of Design: [Smart Gym Control System by Draper, Inc.](#), 7 inch graphic touch screen, or comparable product of listed manufacturer.
  2. Programmable 110-120V AC control processor.
  3. Single and collective device control.
  4. Remote 8-device relay panels, 24V, surface mount.
  5. User Interface: Graphical touch screen, 24V, with four-digit security code.
- H. Basketball Backboard: Competition:
1. Shape and Size:
    - a. Rectangular, 72 by 42 inches width by height.
  2. Backboard Material: With predrilled holes or preset inserts for mounting goals, and as follows:
    - a. Glass: Not less than 1/2-inch-thick, transparent tempered glass. Provide glass with impact-absorbing resilient rubber or PVC gasket around perimeter in a fully welded, painted steel frame, with steel subframe, reinforcement, and bracing and with mounting slots for mounting backboard frame to backboard support framing.

- 1) Glass Retention System: Laminate film surfacing on both surfaces of glass backboard: Clear Defense GRS.
  - 2) Direct Mount: Designed for mounting backboard frame to center mast of backstop framing to maximize relief of stresses on backboard frame and glass.
  - 3) Rim-Restraining Device: Complying with NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
3. Target Area and Border Markings: Permanently etched in white color, marked in pattern and stripe width according to referenced rules.
- I. Basketball Backboards: Practice:
1. Shape and Size:
    - a. Rectangular, 72 by 42 inches width by height.
  2. Backboard Material: With predrilled holes or preset inserts for mounting goals, and as follows:
    - a. Fiberglass: Not less than 1-1/2-inch-thick, composite backboard consisting of not less than two 3/16-inch-thick, molded fiberglass panels laminated together over faces and edges encapsulating a 3/4-inch honeycomb core, reinforced at goal and backboard mountings, or a wood panel product core; with threaded inserts or embedded anchors for mounting backboard corners to support framing at standard mounting centers.
      - 1) Standard Mount: Provide steel corner reinforcement with mounting slots for mounting backboard frame to backstop at standard mounting centers. Provide center-strut frame reinforcement.
      - 2) Rim-Restraining Device: Complying with NCAA and NFHS rules and designed to ensure that basket remains attached if glass backboard breaks.
  3. Target Area and Border Markings: Marked in pattern, stripe width, and color according to referenced rules.
  4. Finish: Manufacturer's standard factory-applied, white background.
- J. Goal Mounting Assembly: Compatible with goal, backboard, and support framing; with hole pattern that is manufacturer's standard for goal attachment.
1. Glass Backboard Goal Mounting Assembly: Goal support framing and reinforcement designed to transmit load from goal to backboard frame and to minimize stresses on glass backboard.
  2. Direct Mount: Designed for mounting goal directly and independently to center mast of backstop support framing so no force, transmitted by ring, is directly applied to backboard and rigidity and stability of goal are maximized.
- K. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
1. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication complying with referenced rules.

2. Type: Movable, breakaway design with manufacturer's standard breakaway mechanism including positive-lock, preset pressure release, set to release at 230-lb load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
  3. Mount: Rear.
  4. Net Attachment: No-tie loops for attaching net to rim without tying.
  5. Finish: Manufacturer's standard finish.
- L. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches long, sized to fit rim diameter, and as follows:
1. Competition Cord: Antiwhip, made from white nylon cord not less than 120- or more than 144-gm thread.
- M. Backboard Safety Pads: Designed for backboard thickness indicated and extending continuously along bottom and up sides of backboard and over goal mounting and backboard supports as required by referenced rules.
1. Attachment: Bolted.
  2. Color: As selected by Architect from manufacturer's full range.

## 2.2 VOLLEYBALL EQUIPMENT

- 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. Draper Inc.
  2. Performance Sports Systems.
  3. Porter Athletic Equipment Company.
  4. Schelde North America.
- C. General: Provide equipment complying with requirements in NFHS's "NFHS Volleyball Rule Book."
- D. Floor Insert: Solid-brass floor plate; and steel pipe sleeve, concealed by floor plate, with capped bottom end, sized with ID to fit post standards, not less than 12 inches long to securely anchor pipe sleeve below finished floor in concrete footing; with anchors designed for securing floor insert to floor substrate indicated; one per post standard.
1. Floor Plate: Minimum 8 inch square, with lockable swivel access cover, designed for use with floating wood floors and to be flush with adjacent flooring. Provide two tool(s) for unlocking access covers.
- E. Post Standards: Removable, paired volleyball post standards and center post standard for multicourt play as indicated. Adjustable, telescoping height. Designed for easy removal from permanently placed floor insert supports. Fabricated from manufacturer's standard metal pipe or tubing, with nonmarking plastic or rubber end cap or floor bumper to protect permanent flooring. Finished with manufacturer's standard factory-applied, baked powder-coating finish



complying with finish manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness or plated metal finish.

1. Nominal Pipe or Tubing Diameter: 3-1/2-inch OD at base.
  2. Telescopic and Net Height Adjuster System: Provide Manufacturer's standard telescoping system with locking device, telescopic post, and fittings for holding net at selected height; designed for height adjustment of post standard to position net at heights indicated.
    - a. Net Heights: Between sitting volleyball net height and boys'/men's volleyball net height, 36 and 95-5/8 inches or more.
  3. Height Markers: Clearly marked at regulation play heights.
- F. Net: 32 feet long and as follows; 1 per pair of paired post standards or 2 per every center post standard, as applicable:
1. Width and Mesh: Competition volleyball net, with 4-inch-square mesh made of black nylon string.
    - a. Hem Band Edges: White, not less than 2-inch-wide top, bottom, and side bindings;; end sleeves for dowels; and lines with linkage fittings threaded through top and bottom hems of binding. Provide lengths of lines and linkage fittings as required to properly connect to and set up net for post standard spacing indicated on Drawings.
      - 1) Top Line: Not less than 1/8-inch-diameter, galvanized or coated steel cable.
      - 2) Bottom Line: Not less than 1/4-inch-diameter rope.
  2. Dowels: Not less than 1/2-inch-diameter fiberglass or 1-inch-diameter wood. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
  3. Net Antennas: 3/8-inch-diameter, high-tensile-strength, extruded fiberglass or plastic rods, 72 inches long, extending above top hem band of net, with alternating white and red bands according to competition rules. Provide two antennas per net.
  4. Boundary Tape Markers: 2-inch-wide white strip with sleeve for securing net antenna, secured to net top and bottom with hook-and-loop attachment. Provide two tape markers per net for marking court boundaries.
- G. Net Tensioning System: Designed to adjust and hold tension of net. Fully enclosed, nonslip manufacturer's standard-type winch with cable length and fittings for connecting to net lines, positive-release mechanism, and manufacturer's standard handle. Mount net tensioner on post standard at side away from court. Provide end post with post top pulley. Provide opposing post with welded steel loops, hooks, pins, or other devices for net attachment and post top grooved line guide.
- H. Bottom Net Lock Tightener: Provide manufacturer's standard quick-release-type tension strap, spring-loaded self-locking tensioner, turnbuckle, pulley, or other device and linkage fittings designed to quickly and easily tighten bottom line or net.

- I. Judges' Stands: Provide manufacturer's standard adjustable-height units designed to be freestanding, folding for storage with wheels for transporting. Fabricate units of welded steel tubing with finish and color to match post standards.
- J. Safety Pads: Comply with NCAA and NFHS requirements. Provide pads consisting of not less than 1-inch-thick, multiple-impact-resistant manufacturer's standard foam filler covered by puncture- and tear-resistant, manufacturer's standard fabric cover; with fire-test-response characteristics indicated, and lined with fire-retardant liner. Provide pads with hook-and-loop closure or attachments for the following components:
  - 1. Post Standards: Wraparound style, designed to totally enclose each standard to a height of not less than 72 inches; 1 per post.
  - 2. Net Lines: Four per net.
  - 3. Judges' Stands: Designed to totally enclose each unit.
  - 4. Fabric Cover Flame-Resistance Ratings: Passes NFPA 701.
  - 5. Fabric Color: As selected by Architect from manufacturer's full line.
- K. Wall Storage Rack: Manufacturer's standard unit designed for mounting on walls and for storing post standards in vertical position with retaining arms, fittings for padlock, and mounting hardware; number of units as required to provide storage for specified equipment.

### 2.3 SAFETY PADS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Draper Inc.
  - 2. Performance Sports Systems.
  - 3. Porter Athletic Equipment Company.
- B. Safety Pad Surface-Burning Characteristics: ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. Pad Coverings: Provide safety pad fabric covering fabricated from puncture- and tear-resistant, not less than 14-oz./sq. yd. PVC-coated polyester or nylon-reinforced PVC fabric treated with fungicide for mildew resistance; with surface-burning characteristics indicated and lined with fire-retardant liner.
- D. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.
  - 1. Backer Board: Not less than 3/8-inch-thick plywood, mat formed, or composite panel fire-retardant-treated plywood per AWPA C27, Interior Type A.
  - 2. Fire-Resistive Fill: Multiple-impact-resistant foam not less than 2-inch-thick, fire-resistive neoprene; 6.0-lb/cu. ft. density.
  - 3. Size: Each panel section, manufacturer's standard dimensions.
  - 4. Number of Panel Sections: As indicated modular panel sections.

5. Installation Method: Concealed mounting without exposed fasteners.
6. Fabric Covering Color(s): As selected by Architect from manufacturer's full line.

## 2.4 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
  2. Cast Aluminum: ASTM B 179.
  3. Flat Sheet: ASTM B 209.
- B. Steel: Comply with the following:
  1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
  2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
  3. Steel Sheet: ASTM A 1011/A 1011M.
- C. Support Cable: Manufacturer's standard galvanized steel aircraft cable. Provide fittings complying with cable manufacturer's written instructions for size, number, and method of installation.
- D. Support Chain and Fittings: Grade 80 hardened alloy steel chain rated for overhead lifting, ASTM A 391/A 391M, with commercial-quality, hot-dip galvanized steel connectors and hangars.
- E. Castings and Hangers: Malleable iron, ASTM A 47/A 47M, grade required for structural loading.
- F. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Softwood Plywood: DOC PS 1, exterior.
- H. Equipment Wall-Mounting Board: Wood, neutral-color painted finish, size, and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.
- I. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.
- J. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by gymnasium equipment manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.

1. Verify critical dimensions.
2. Examine supporting structure and subgrades, subfloors and footings below finished floor.
3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements have been clearly marked. Locate reinforcements and mark locations.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly, where required.
- B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, have been completed.
- C. Permanently Placed Gymnasium Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with court layout.
  1. Floor Insert Location: Coordinate location with application of game lines and markers.
  2. Floor Insert Elevation: Coordinate installed heights of floor insert with installation and field finishing of finish flooring and type of floor plate.
  3. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.
- D. Floor Insert Setting: Position sleeve in oversized, recessed voids in concrete slabs and footings. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions. Protect portion of sleeve above subfloor and footing from splatter. Verify that sleeves are set plumb, aligned, and at correct height and spacing; hold in position during placement and finishing operations until grout is sufficiently cured. Set insert so top surface of completed unit is flush with finished flooring surface.
- E. Wall and Column Safety Pads: Mount with bottom edge at 4 inches above finished floor unless otherwise indicated on Drawings.
- F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.
- G. Connections: Connect automatic operators to building electrical system.
- H. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration has been approved by Architect, and store units in location indicated on Drawings.

### 3.3 ADJUSTING

- A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

### 3.4 CLEANING

- A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
- B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

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## SECTION 116643 – INTERIOR SCOREBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior multi-sport scoreboards.

B. Related Sections:

1. Division 26 Sections for electrical service and connections including device boxes for switches and conduit, where required, for low-voltage control wiring, and for pulling control wiring between scoreboards and control location.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product and accessory indicated.

B. Shop Drawings: For interior scoreboards. Show layout including logo sponsor panel. Include the following:

1. Location of scoreboards.
2. Location of wiring connections for electrically operated units.
3. Anchorage details, including connection to supporting structure for suspended units, and seismic restraints where required.
4. Accessories.
5. Wiring diagrams.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Maintenance Data: For scoreboards to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

A. Source Limitations for Scoreboards: Obtain interior and exterior scoreboards and consoles from single manufacturer.

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

#### 1.5 COORDINATION

A. Coordinate layout and installation of scoreboards with adjacent construction, including ceiling suspension systems, light fixtures, HVAC equipment, fire-suppression system, and partitions.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis of Design Product: Subject to requirements, provide [Fair Play Basketball Scoreboard, Model BB-1850-4](#), or comparable product of one of the following manufacturers:
1. Daktronics.
  2. Fair Play.
  3. Electro-Mech Scoreboard Company.
  4. Nevco Scoreboard Company.
  5. Spectrum Corporation.

## 2.2 INTERIOR SCOREBOARDS

- A. Interior Multi-Sport Scoreboards: Two units required in master and slave configuration: Manufacturer's standard single-sided units, consisting of scoreboard, battery pack, mounting accessories, and other components necessary for a complete installation, complying with UL-48 and UL-1433. Include single control console with wireless controls. Provide the following:
1. Display the following:
    - a. Score HOME and GUEST to 199.
    - b. Indicate period to nine, team FOULS to 99, PLAYER number to 99, player FOUL to 9, T.O.L (time outs left) to 9.
    - c. Indicate possession and bonus.
    - d. Display period time to 59:59, and during last minute of period, display time to 1/10 of a second.
  2. Size: 10 by 6 foot with 13 and 10 inch digits.
  3. Cabinet: Aluminum, minimum 0.063 inch thick, with digit faceplates minimum 0.090 inch thick.
  4. Digits: Seven-bar LED digits with 140 degree viewing angle.
    - a. Clock and score digits: 13 inch high.
    - b. PERIOD and time outs left digits: 10 inch high.
    - c. Clock, colon, period digits and bonus indicators: Amber LEDs.
    - d. Score digits and possession indicators: Red LEDs.
  5. Captions:
    - a. White vinyl applied directly to scoreboard face.
    - b. HOME and GUEST captions: 6 inch high.
    - c. PERIOD caption: 4 inch high.
  6. Power: 120 VAC, 200W, with cord and plug for standard outlet.
  7. Color: As selected by Architect from manufacturer's full line to match school colors.
  8. Configuration: One master unit and one slave unit, located as indicated.
  9. Scoreboard Accessories: Include the following:
    - a. Vibrating horn: Clock automatic plus operator manual.
    - b. Visual horn indicator.



## 2.3 SCORING CONSOLE

- A. Scoring Console, General: Provide single console for interior scoreboards.
  - 1. Basis of Design: [Fair Play MP-80](#).
  - 2. Score specified sports through the use of keyboard inserts.
  - 3. Control other specified scoreboards.
  - 4. Recall clock, score, and period information if power is lost.
  - 5. Provide two (2) consoles with carrying cases for each.
- B. Console to include:
  - 1. Aluminum enclosure to house electronics.
  - 2. Sealed membrane water-resistant keyboard.
  - 3. 32-character backlit liquid crystal prompting display to verify entries and recall information currently displayed.
  - 4. 120 VAC, 5W, with 6 foot power cord to standard outlet.
  - 5. 20 foot control cable to connect to the control receptacle junction box.
- C. Practice timer mode:
  - 1. Sound horn at the end of each segment.
  - 2. 99 programmable segments.
  - 3. Display segment number and segment length.
  - 4. Programmable interval time.
- D. Console Accessories:
  - 1. Carrying case for console.
  - 2. 2.4 GHz spread spectrum radio for scoreboard control.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify substrate and structure are ready to receive work. Verify placement of power and control conduit, junction boxes, and outlets are as specified and indicated in plans and shop drawings.

### 3.2 SCOREBOARD INSTALLATION

- A. Install scoreboards at locations indicated; comply with manufacturer's written instructions.
- B. Install scoreboards in position and in relation to adjoining construction indicated. Securely anchor to and suspend from supporting structure with edges plumb and level.
  - 1. Install low-voltage controls according to NFPA 70 and complying with manufacturer's written instructions.
  - 2. Test electrically operated units to verify that controls are in optimum functioning condition.

### 3.3 DEMONSTRATION AND TRAINING

- A. Train Owner's personnel in operation of scoreboard and controller.

END OF SECTION

## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations. Indicate required blocking.

C. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

E. Roller-Shade Schedule: Use same designations indicated on Drawings.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products of MechoShade Systems, Inc; or comparable products by one of the following:
  - 1. Draper Inc.
  - 2. Hunter Douglas Contract.
  - 3. Lutron Electronics Co., Inc.
- B. Source Limitations: Obtain both manual and electric roller shades from single source from single manufacturer.

## 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Bead Chains: Manufacturer's standard meeting WCMA A 100.1.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Chain tensioner, jamb mounted.
  - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
    - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - 1. Roller Drive-End Location: Right side of inside face of shade.
  - 2. Direction of Shadeband Roll: Regular, from back of roller.
  - 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

### 2.3 SHADEBAND MATERIAL

- A. Shadeband Material: Light-filtering fabric.
  - 1. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- B. Installation Accessories:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
    - a. Shape: L-shaped.
    - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches.
  - 2. Endcap Covers.
  - 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

### 2.4 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  - 1. Basis of Design: Mechoshade, Ecoveil Sheer.
  - 2. Type: PVC-free polyester.
  - 3. Weave: Basketweave.
  - 4. Openness Factor: 3 percent.
  - 5. Color: As selected by Architect from manufacturer's full range.

### 2.5 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  - 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
  - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
  - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

#### 3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### 3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

## SECTION 123216 - MANUFACTURED PLASTIC-LAMINATE-CLAD CASEWORK

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes plastic-laminate-faced cabinets of stock design.
- B. Related Requirements:
  - 1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring casework.
  - 2. Section 092216 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring casework.
  - 3. Section 096513 "Resilient Base and Accessories" for resilient base applied to plastic-laminate-faced casework.

## 1.2 DEFINITIONS

- A. Definitions in the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" apply to the work of this Section.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.
- D. Keying Schedule: Include schematic keying diagram and index each key set to unique designations that are coordinated with the Contract Documents.
- E. Samples for Initial Selection: For cabinet finishes.
- F. Samples for Verification: 8-by-10-inch Samples for each type of finish.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
- C. Sample Warranty: For special warranty.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer listed in this Section.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework 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. Maintain temperature and relative humidity during the remainder of the construction period in range recommended for Project location by the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

## 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of casework that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of components or other failures of glue bond.
    - b. Warping of components.
    - c. Failure of operating hardware.



2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. CampbellRhea.
  2. Case Systems Inc.
  3. LSI Corporation of America.
  4. Stevens Industries, Inc.
  5. TMI Systems Design Corporation.
- B. Source Limitations: Obtain plastic-laminate-faced cabinets from single manufacturer.

### 2.2 CASEWORK, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the ANSI/AWI 1232 – Manufactured Wood Casework, which replaces sections of the 2014 edition of Architectural Woodwork Standards, construction, finishes, installation, and other requirements.
- B. Product Designations: Drawings indicate sizes, configurations, and finish materials of manufactured plastic-laminate-faced cabinets by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish materials, and complying with the Specifications may be considered. See Section 016000 "Product Requirements."

### 2.3 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

### 2.4 CASEWORK

- A. Design:
  1. Flush overlay.
- B. Exposed Materials:
  1. Plastic Laminate: Grade HGS.
  2. Unless otherwise indicated, provide specified edgebanding on all exposed edges.
- C. Semiexposed Materials:
  1. Plastic Laminate: Grade VGS unless otherwise indicated. Provide plastic laminate for semiexposed surfaces unless otherwise indicated.

- a. Provide plastic laminate of same grade as exposed surfaces for interior faces of doors and drawer fronts and other locations where opposite side of component is exposed.
  2. Unless otherwise indicated, provide specified edgebanding on all semiexposed edges.
- D. Concealed Materials:
1. Plastic Laminate: Grade BKL.

## 2.5 MATERIALS

- A. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Formica Corporation.
    - b. Nevamar; a Panolam Industries International, Inc. brand.
    - c. Wilsonart.
- D. Edgebanding for Plastic Laminate: Rigid ABS extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

## 2.6 COLORS AND FINISHES

- A. Thermoset Decorative Panel Colors, Patterns, and Finishes: As indicated by manufacturer's designations, or if not indicated, as selected by Architect from thermoset decorative panel manufacturer's full range of solid colors.
- B. Plastic-Laminate Colors, Patterns, and Finishes: As scheduled.
- C. Edgebanding Color: As selected from casework manufacturer's full range.

## 2.7 FABRICATION

- A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:
  1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
  2. Shelves: 3/4-inch plywood, plastic-laminate faced.
  3. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
  4. Drawer Fronts: 3/4-inch particleboard, plastic-laminate faced.
  5. Drawer Sides and Backs: 1/2-inch thermoset decorative panels, with glued dovetail or multiple-dowel joints.

6. Drawer Bottoms: 1/4-inch thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
  7. Doors: 3/4-inch particleboard with wood stiles and rails, plastic-laminate faced.
- B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.
- C. Leg Shoes: Rubber, black, open-bottom type.
- 2.8 CASEWORK HARDWARE AND ACCESSORIES
- A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard powder-coated, commercial-quality, heavy-duty hardware.
1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.
- B. Butt Hinges: Powder-coated, semiconcealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.
- C. Pulls: Solid stainless-steel wire pulls, fastened from back with two screws. For sliding doors, provide recessed stainless-steel flush pulls. Provide 2 pulls for drawers more than 24 inches wide.
- D. Door Catches: Powder-coated, nylon-roller spring catch. Provide 2 catches on doors more than 48 inches high.
- E. Drawer Slides: BHMA A156.9, Type B05091.
1. Standard Duty (Grades 1, 2, and 3): Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
  2. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-overtravel-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 1HD-100, for computer keyboard shelves.
- F. Drawer and Hinged Door Locks: Mortise type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
1. Provide a minimum of two keys per lock and six master keys.
  2. Provide locks on all doors and drawers.
  3. Key locks alike per room with separate keying for each room, with master key for building.
  4. Coordinate keying with keying for millwork and casework provided under other sections.
- G. Sliding-Door Hardware Sets: Manufacturer's standard, to suit type and size of sliding-door units.

- H. Adjustable Shelf Supports: 2-pin locking shelf rests complying with BHMA A156.9, Type B04013, 100 lb. minimum capacity.
- I. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

## 2.9 WALL SHELVING

- A. Plastic-Laminate Shelving: Plastic-laminate sheet, Grade HGL, shop bonded to both sides of plywood. Sand surfaces to which plastic laminate is to be bonded.
  - 1. Shelf Thickness: 1 inch.
  - 2. Edge Treatment: Finish both edges with plastic laminate that matches faces.
- B. Adjustable Shelf Supports: Powder-coated steel standards and shelf brackets, complying with BHMA A156.9, Types B04102 and B04112, surface mounted.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CASEWORK INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Install casework level, plumb, and true; shim as required, using concealed shims. Where casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions. Align similar adjoining doors to a tolerance of 1/16 inch.
- E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

- G. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

### 3.3 INSTALLATION OF SHELVING

- A. Securely fasten shelf standards to masonry, partition framing, wood blocking, or reinforcements in partitions.
  - 1. Fasten shelf standards at ends and not more than 12 inches o.c.
  - 2. Use toggle bolts at hollow masonry.
  - 3. Use expansion anchors at solid masonry.
  - 4. Use self-tapping sheet metal screws in metal framing or metal backing at metal-framed partitions. Do not use wall anchors in gypsum board.
  - 5. Use wood screws sized for 1-inch penetration into wood framing or blocking at wood-framed partitions.
- B. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Space standards not more than 30 inches o.c.
- C. Install shelving level and straight, closely fitted to other work where indicated.

### 3.4 CLEANING

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces touch up as required and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

END OF SECTION

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## SECTION 123616 - METAL COUNTERTOPS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this section shall be bound by the documents and general provisions of the Contract, including the General and Supplementary Conditions, Division 00 Procurement and Contracting Requirements and Division 01 General Requirements in their entirety.

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Stainless-steel countertops.

## 1.3 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded wall-mounted shelves.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.
  - 3. For wall-mounted shelves, indicate requirements for blocking or reinforcements in supporting construction.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products only after casework and supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

## 1.6 FIELD CONDITIONS

- A. Field Measurements: Where products are 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.

- B. Established Dimensions: Where products are indicated to fit to other construction, establish dimensions for areas where products are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.1 STAINLESS-STEEL FABRICATIONS

- A. Countertops: Fabricate from 0.062-inch-thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1-1/2 inch over the base cabinets.
  - 1. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
  - 2. Weld shop-made joints.
  - 3. Sound deadens the undersurface with heavy-build mastic coating.
  - 4. Extend the top down to provide thickened edge and return flange.
  - 5. Form the backsplash coved to and integral with top surface.
  - 6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
  - 7. Refer to Drawing details for dimensions.

### 2.2 MATERIALS

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 079200 "Joint Sealants" and the following:
  - 1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
  - 2. Color: Clear.

### 2.3 STAINLESS-STEEL FINISH

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

## 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 products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.



- B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- C. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- E. Seal junctures of countertops, splashes, and walls with sealant for countertops.

### 3.3 CLEANING AND PROTECTION

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION

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## SECTION 123663 - SOLID SURFACING COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid surface material countertops.
  - 2. Countertop support brackets.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop and windowsill materials.
- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.
- C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
  - 1. Show locations and details of joints.
  - 2. Show direction of directional pattern, if any.
- D. Samples for Verification: For the following products:
  - 1. Countertop and Windowsill material, manufacturer's standard sample size not less than 6 inches square.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

#### 1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate work similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.

#### 1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops and windowsills by field measurements before fabrication is complete.

#### 1.6 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes and windowsills.

## PART 2 - PRODUCTS

## 2.1 SUSTAINABILITY REQUIREMENTS

- A. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:

1. **Low-Emitting Materials: Adhesives and Sealants.**

## 2.2 SOLID SURFACE MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings or a comparable product acceptable to Architect by one of the following:
    - a. DuPont; DuPont de Nemours, Inc.
    - b. Formica Corporation.
    - c. Wilsonart LLC.
  2. Type: Provide Standard type unless Special Purpose type is indicated.
  3. Colors and Patterns: As indicated by manufacturer's designations.

## 2.3 INSTALLATION MATERIALS

- A. Countertop Support Bracket: Surface-mounted support bracket configured to support countertop directly off wall, with 12-inch vertical flange, of length required for application indicated on Drawings.
1. Product: Rakks, [Concealed EH Counter Support Bracket](#).
  2. Depth dimension: As required by application
  3. Color: Mill.
- B. Adhesive: Low-emitting product recommended by solid surface material manufacturer.
- C. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## 2.4 COUNTERTOPS, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with ANSI/AWI 1236 - *Countertops* and ANSI/AWI 0620 *Finish Carpentry/Installation Standard* which replaces Section 11 of the 2014 edition of *Architectural Woodwork Standards* for grades and duty levels of countertops indicated for materials, fabrication, finishes, installation and other requirements.
1. Aesthetic Grade: Custom.
  2. Duty Level: 3.
- B. Configuration:
1. Front: Straight, slightly eased at top, with 1-inch nosing.
  2. Backsplash: Straight, slightly eased at corner.

3. End Splash: Matching backsplash.
- C. Countertops: 3 cm-thick, solid surface material with front edge built up with same material.
- D. Backsplashes: 1/2-inch-thick, 4-inch-high solid surface material.
- E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
  1. Fabricate with loose backsplashes for field assembly.
  2. Install integral sink bowls in countertops in the shop.
- F. Joints: Fabricate straight countertops eight feet or less in length without joints. Where size and configuration of countertops exceed dimensions of solid surface slab, fabricate countertops in sections for joining in field, with joints at locations indicated on approved Shop Drawings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates to receive solid surface material windowsills and conditions under which windowsills will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of windowsills.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF COUNTERTOPS

- A. Countertop Support Brackets: Install countertop support brackets in accordance with manufacturer's written instructions and approved shop drawings.
- B. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- C. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
  2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned, and joints are of specified width.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

## SECTION 126600 - TELESCOPING STANDS

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Electrically operated telescoping stands.

## 1.2 DEFINITIONS

- A. Forward Folding: Wall- or floor-attached bleachers that open in the forward direction by moving the front row away from the stack to the fully extended position.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.4 ACTION SUBMITTALS

## A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.
2. Include load capacities, assembly characteristics, and furnished accessories.
3. Include electrical characteristics of electrical components, devices, and accessories.
4. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
5. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

- B. Sustainable Design Submittals: Submit verification of compliance with sustainability requirements categories listed in Part 2 in accordance with Section 018113.

## C. Shop Drawings: For telescoping stands in both stacked and extended positions.

1. Include plans, elevations, sections, and attachment details.
2. Include load capacities.
3. Show seating layout, aisle widths, and wheelchair accessibility provisions.
4. Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
5. Include diagrams for power, signal, and control wiring.

- D. Samples for Initial Selection: For each type of exposed product and for each color and texture required.

1. Include Samples of accessories involving color and finish selection.

- E. Samples for Verification: For the following products prepared on Samples of size indicated below:

1. Decking: 6-inch-square Samples of finished material.
2. Seating Material: 6-inch-square Sample of each seating material, color, and finish indicated.
3. Seat Unit: Full-size unit of each type.
4. Signage: Full-size units for [**each type of accessibility sign**] [**and**] [**custom graphics**].

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of telescoping stand assembly.
- B. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For telescoping stands to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Procedures for conducting periodic inspections.
    - b. Precautions for cleaning materials and methods that could be detrimental to telescoping stand finishes and performance.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and is licensed to perform work in the Project jurisdiction.
  1. Installer shall be capable of providing maintenance service as required in Part 3 Article "Maintenance Service." Submit documentation indicating capability of compliance.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

#### 1.8 FIELD CONDITIONS

- A. Finished Spaces: Do not deliver or install telescoping stands until finishes in spaces to receive them are complete, including suspended ceilings, floors, and painting.
- B. Field Measurements: Indicate measurements on Shop Drawings.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of telescoping stands that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:



- a. Structural failures including seating, decking, railings, power units and controls, and attached components.
  - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Telescoping stands shall withstand the effects of gravity loads, operational loads, and other loads and stresses according to ICC 300.
- B. Accessibility Standard: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.
- C. Sustainability Requirements: Comply with the requirements for material selection categories applicable to Project as indicated in Section 018113, including the following:
  1. Low-Emitting Materials: Adhesives and Sealants.
  2. Low-Emitting Materials: Composite Wood or Agrifiber Products.

### 2.2 TELESCOPING STANDS

- A. System Description: Operable system of multiple-tiered seating on interconnected folding platforms that close for storage, without being dismantled, into a nested stack. Telescoping-stand units permit opening and closing of adjacent, individual and multiple rows, and close with vertical faces of platforms in the same vertical plane.
  1. Electrical Components, Devices, and Accessories, and Completed Assembly: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    - a. Provide UL-labeled electrical system that encloses the connection to the building power and telescoping system meeting requirements of authorities having jurisdiction.
  2. Telescoping-Stands Standard: ICC 300.
- B. Wall-Attached Telescoping Stands: Forward-folding system, in which the bleachers open in the forward direction by moving the front row away from the stack to the fully extended position and the rear of bleacher understructure permanently attaches to wall construction.
  1. Available Manufacturers: Subject to compliance with requirements, provide stands in same style and material and, if possible, from same manufacturer as existing stands, which are from Interkal with Excel seat modules. If It is unavailable, submit proposed substitute for approval. Manufacturers offering products that may be incorporated into the Project include the following:
    - a. Hussey Seating Company.
    - b. Interkal LLC.
    - c. Irwin Telescopic Seating Company; Irwin Seating Company.

2. Row Spacing: As indicated on Drawings.
3. Row Rise: As indicated on Drawings.
4. Seat Type: Benches, size as indicated on Drawings.
5. Operation: Electrically operated, with friction-type, integral power unit mounted under seating.
6. Electrical Characteristics for Each Seating Section: As follows, unless otherwise indicated on approved submittals:
  - a. Horsepower: Not less than 1/2.
  - b. Voltage: 208 V ac, three phase, 60 hertz.
7. Electrical Controls:
  - a. Control Devices: Wall mounted.
  - b. Limit Switches: Automatically stop power system when telescoping stands reach fully opened or closed positions.
  - c. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during operation.
  - d. Enclosed power unit and gear box chain housings. Locate unit under second tier.

## 2.3 COMPONENTS

- A. Benches: Seats and skirts.
  1. Material: Molded plastic with contour surfaces, fully enclosed module.
    - a. Color: Single color as selected by Architect from manufacturer's standard.
- B. Wheelchair-Accessible Seating: Locate retractable truncated first row bench section to provide wheelchair-accessible seating and companion seating without the use of front rails, at locations indicated on Drawings.
  1. Equip tiers adjacent to wheelchair-accessible seating with front rails as required by ICC 300.
  2. Equip cutouts with full-width front and side closure panels that match decking construction and finish and that extend from underside of tiers adjacent to cutouts to 1-1/2 inches from finished floor.
- C. Deck: Plywood, 3/4-inch-thick A/C grade or 5/8-inch-thick tongue and groove.
  1. Finish: Transparent.
- D. Risers: Steel sheet with manufacturer's standard, rust-inhibiting coating or hot-dip galvanized finish.
- E. Safety Rails: Steel, finished with manufacturer's standard powder coat system.
  1. Automatic rotating self-storing mid-aisle handrails located at centerline of each vertical aisle with seating on both sides. First row rails to manually rotate for safety requirements.
  2. End rails (guards) that are telescoping and self-storing.
  3. Color: As selected by Architect from manufacturer's standard colors.

- F. Understructure: Structural steel.
  - 1. Finish: Manufacturer's standard rust-inhibiting finish.
  - 2. Color: Manufacturer's standard.
- G. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.
  - 1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but no fewer than four per column or less than five inches in diameter and 1-1/4 inch wide.
  - 2. Floor Loading: Maximum 220 psi.
- H. Control Devices:
  - 1. Walk-Along Pendant: Manufacturer's standard unit, which plugs into first row of each operating section. Provide two units.
- I. Fasteners: Vibration proof, in manufacturer's standard size and material.

## 2.4 ACCESSORIES

- A. Steps:
  - 1. Slip-resistant, abrasive tread nosings at aisles.
  - 2. Intermediate aisle steps, fully enclosed, at each aisle.
  - 3. Transitional top step, fully enclosed, at each aisle where last row of telescoping stands is adjacent to a cross aisle.
  - 4. Removable front steps, fully enclosed, at each aisle, that engage with front row to prevent accidental separation or movement and are equipped with a minimum of four skid-resistant feet.
- B. Closure Panels and Void Fillers:
  - 1. End closure curtain covering exposed ends of stands in the open position.
  - 2. Panels at cutouts and truncations for accessible seating.
  - 3. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
  - 4. Gap fillers for closing openings between stand units or between stand units and adjoining construction.
- C. Signage:
  - 1. Accessibility signs at each accessible space.
  - 2. Graphics as indicated on Drawings.

## 2.5 MATERIALS

- A. Plywood: PS 1 as standard with manufacturer.

- B. Molded Plastic: High-density polyethylene; blow or injection molded, color-pigmented, textured, impact-resistant, with integral reinforcing ribs for attachment and anchoring points. Provide with UV inhibitors to retard fading.

## 2.6 FABRICATION

- A. Fabricate telescoping stands to operate easily without special tools or separate fasteners unless otherwise indicated.
- B. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.
- C. Form exposed work with flat, flush surfaces, level and true in line.
- D. Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair their usefulness.
  - 1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

## 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. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install telescoping stands according to ICC 300 and manufacturer's written instructions.

### 3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, lubricate, test, and adjust each telescoping stand unit to operate according to manufacturer's written instructions.
- B. Clean installed telescoping stands on exposed and semi-exposed surfaces. Touch up factory-applied finishes or replace components as required to restore damaged or soiled areas.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. ICC 300 Inspection: Inspect installed telescoping stands to verify that construction, installation, and operation are according to ICC 300 requirements.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Telescoping stands will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, lubricate, test, and adjust each telescoping stand unit to operate according to manufacturer's written instructions.
- B. Clean installed telescoping stands on exposed and semiexposed surfaces. Touch up factory-applied finishes or replace components as required to restore damaged or soiled areas.

### 3.6 DEMONSTRATION

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

### 3.7 MAINTENANCE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of telescoping stands Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper telescoping stands operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 1. Perform maintenance during normal working hours.
  - 2. Perform emergency callback service during normal working hours with response time of four hours or less.

END OF SECTION

## SECTION 142123 - MACHINE-ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes machine-room-less electric traction passenger elevators.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples: For each type of exposed finish involving color selection.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.
- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

## 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard five-year maintenance agreement, starting on date initial maintenance service is concluded.

## 1.5 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ThyssenKrupp Evolution 500, or a comparable product by one of the following:
1. [KONE Inc; Monospace 500](#)
  2. [Otis Elevator Co., Gen 2.](#)

## 2.2 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

## 2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
1. Rated Load: 2100 lb.
  2. Rated Speed: 150 fpm.
  3. Operation System: Selective-collective automatic operation.
  4. Auxiliary Operations:
    - a. Battery-powered automatic evacuation.
    - b. Automatic operation of lights and ventilation fans.
  5. Car Enclosures:
    - a. Inside Width and Inside Depth: As indicated on Drawings; meet local requirements for emergency medical service stretchers.
    - b. Inside Height: Not less than 93 inches to underside of ceiling.
    - c. Front Walls (Return Panels): Textured stainless steel.
  6. Car Fixtures:
    - a. Side and Rear Wall Panels: Textured stainless steel.
    - b. Door Faces (Interior): Textured stainless steel.
    - c. Ceiling: Polished stainless steel, No. 8 finish.
    - d. Handrails: 1-1/2 inches flat satin stainless steel, No. 4 finish, at rear of car.
    - e. Floor prepared to receive ceramic tile as scheduled.
  7. Hoistway Entrances:
    - a. Width: 36 inches.
    - b. Height: 84 inches.

- c. Type: Single-speed side sliding.
  - d. Frames: Satin stainless steel, No. 4 finish.
  - e. Doors: Textured stainless steel.
8. Hall Fixtures: Satin stainless steel, No. 4 finish.
9. Additional Requirements:
- a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
  - b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

## 2.4 TRACTION SYSTEMS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
  - 1. Provide regenerative system that complies with the IgCC.
  - 2. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
- B. Fluid for Hydraulic Buffers: Fire-resistant fluid.
- C. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- D. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

## 2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Auxiliary Operations:
  - 1. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.

## 2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

## 2.7 CAR ENCLOSURES

- A. General: Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with removable car roof, access doors, power door operators, and ventilation.



1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Stainless-Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless-steel sheet.
2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
3. Sight Guards: Provide sight guards on car doors.
4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
5. Metal Ceiling: Flush panels, with four low-voltage downlights in each panel. Align ceiling panel joints with joints between wall panels.
6. Light Fixture Efficiency: Not less than 35 lumens/W.
7. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

## 2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.

1. Fire-Protection Rating: 1 hour.

C. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Stainless-Steel Frames: Formed from stainless-steel sheet.
2. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled or powder-coated steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
3. Sight Guards: Provide sight guards on doors matching door edges.
4. Sills: Extruded or machined metal, with grooved surface, 1/4 inch thick.
5. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

## 2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.

- B. Car-Control Stations: Provide manufacturer's vandal-resistant recessed or semi-recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
  - 1. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- E. Hall Push-Button Stations: Provide one hall push-button station at each landing.
  - 1. Manufacturer's vandal-resistant wall-mounted units, for mounting above entrance frames.
- F. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
- G. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- H. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## 2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Stainless-Steel Bars: ASTM A 276, Type 304.
- E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- F. Aluminum Extrusions: ASTM B 221, Alloy 6063.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- B. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- C. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.
- D. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- E. Locate hall signal equipment for elevators as follows unless otherwise indicated:

## 3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

## 3.3 PROTECTION

- A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 3. Engage elevator Installer to provide full maintenance service.
  - 4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

## 3.4 DEMONSTRATION

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

## 3.5 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity.

END OF SECTION

## SECTION 210000 - SPRINKLER GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SCOPE

1.2 This section as well as the Drawing and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 – General Sections included in Division 21 Specifications are for sprinkler and related work. Coordinate with plans and other specifications sections.

#### 1.3 RELATED DOCUMENTS

- A. SECTION 21 00 00 - SPRINKLER SYSTEMS GENERAL REQUIREMENTS
- B. SECTION 21 05 00 – SPRINKLER BASIC MATERIALS AND METHODS
- C. SECTION 21 05 13 – COMMON MOTOR REQUIREMENTS FOR FIRE PROTECTION
- D. SECTION 21 05 53 – IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT
- E. SECTION 21 11 19 – FIRE DEPARTMENT CONNECTIONS
- F. SECTION 21 13 13 - WET PIPE SPRINKLER SYSTEM
- G. SECTION 21 31 13 – ELECTRIC-DRIVE, CENTTRIFUGAL FIRE PUMPS
- H. SECTION 21 34 00 – PRESSURE-MAINTENANCE PUMPS

#### 1.4 WORK INCLUDED

- A. The work covered by this Division of the Specifications consists of furnishing all plant, labor, equipment, supervision, appliances, and materials, and in performing all operations in connection with the fire protection systems complete and in strict accordance with this Division of the Specifications and the applicable drawings.

#### 1.5 COORDINATION OF WORK

- A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work, including electrical work, and that such establishment is the exclusive responsibility of the Contractor.

- B. Advise other trades of openings required in their work for the subsequent move-in of large equipment.
- C. Submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.
- D. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- E. Verify all dimensions by field measurements.
- F. Arrange for chases, slots, and openings in other building components to allow for installation.
- G. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- H. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the installation areas.
- I. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials. Comply with Division 1.
- J. Install equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- K. Coordinate the installation of materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- L. Contractor shall visit the site before bidding to familiarize himself with conditions under which he will have to perform his Contract.

#### 1.6 EXISTING CONDITIONS

- A. The utilities and information shown on the drawings are based on information provided to the designers by the architect or utility company. Contractor shall field verify existing conditions and notify architect in writing of any discrepancies prior to commencing with new work.
- B. All existing piping and materials not to be reused and becoming surplus or abandoned shall be removed from the premises and shall be property of the Contractor, unless otherwise noted

#### 1.7 INTERRUPTION OF SERVICES

- A. All work shall be accomplished at a time most convenient to the Owner and so that the interruption of service shall be minimum and only for changeover.

- B. No service shall be interrupted, or changeover begun until the time and duration of service interruption have been agreed to, in writing, signed by the Owner's Representative, the Architect, and the Contractor.
- C. Temporary connections, or temporary rerouting, to serve existing facilities will be required as the work progresses. Make due allowances in bid.
- D. The sprinkler system shall not be shut down or "impaired" for more than ten (10) hours within a twenty-four (24) hour period. If the "impairment" exceeds the stipulated time, the Contractor shall notify the State Fire Marshal, the local authority having jurisdiction and Owner prior to shutting down the sprinkler system. The Contractor shall provide a fire watch as required by NFPA 25.

1.8 The Contractor is responsible for re-connecting all existing sprinkler systems or items to remain such that they are in the same operable condition as prior to construction. It is the Contractor's sole responsibility to trace the existing systems prior to demolition to ensure that all existing systems to remain will remain operable. At no additional cost to the Owner, the Contractor shall extend existing or new systems to serve those components should any portion of those systems be removed.

#### 1.9 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.
- B. Provide system to NFPA 13, 2016 edition, requirements.
- C. Interface system with building fire and smoke alarm system.

#### 1.10 SYSTEM DESIGN

- A. Sprinkler systems shall be designed in accordance with the 2016 edition of NFPA 13 requirements and shall be hydraulically designed. When quick response sprinkler sprinklers are installed throughout, the hydraulic area may be reduced as allowed by NFPA 13 requirements.
- B. The Contractor shall include a minimum 5.0 psig safety margin in his calculations between the system demand pressure and the available pressure at the required demand flow.

#### 1.11 SUBMITTALS

- A. Submit under provisions of Division 1.
- B. Shop Drawings: Provide hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls. Shop drawings shall show reflected ceiling layout, lights, diffusers, etc.

- C. Product Data: Provide data on sprinkler sprinklers, valves, and specialties, including manufacturer's catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections.
- D. Submit shop drawings, product data, and hydraulic calculations to Owner's insurance underwriter for approval. Submit proof of approval to Architect.
- E. Current Fire Pump flow test report.
- F. Contractor shall fill out and submit "Plan Review Application for Fire Protection Systems" application for review by the Louisiana Department of Public Safety and Corrections - Office of State Fire Marshal along with a check for the appropriate plan review fee.
- G. Contractor shall fill out and submit "Signaling/Suppression Permit Application", as required by the City of New Orleans - Department of Fire (New Orleans Fire Prevention Division), along with a check for the appropriate permit fee.
- H. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds the specified requirements.
- I. Contractor's Certificate: Submit Contractor's "Test and Materials Certificates" to show that the system has been tested and meets or exceeds the specified requirements.

#### 1.12 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Record actual locations of sprinkler sprinklers and deviations of piping from Drawings. Indicate drain and test locations.

#### 1.13 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include components of system, servicing requirements, Record Drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

#### 1.14 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13 requirements.
- B. Equipment and Components: Bear UL and FM label or marking.
- C. All piping shall be coated on the inside with a factory applied coating known to inhibit corrosion from microbiological organisms, Wheatland's MIC-Shield, or equal.
- D. Welding of galvanized pipe shall not be allowed.

#### 1.15 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this Section with minimum five (5) years experience.
- B. Design sprinkler system under direct supervision of a Certified "NICET" Level - III Designer experienced in design of this work and licensed in the State of Louisiana.

#### 1.16 REGULATORY REQUIREMENTS

- A. Hydraulic Calculations, Product Data, and Shop Drawings: Bear stamp of approval of State Fire Marshal and Owner's fire insurance underwriter.

#### 1.17 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products to site under provisions of Division 1.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

#### 1.18 EXTRA MATERIALS

- A. Furnish under provisions of Division 1.
- B. Provide extra sprinklers as required by the provisions of NFPA 13.
- C. Provide suitable wrenches for each sprinkler type.
- D. Provide metal storage cabinet to be located in the main mechanical equipment room.

#### 1.19 ELECTRICAL WORK

1.20 Refer to Division 26 for all electrical work as it pertains to work specified in this section.

### PART 2 - PRODUCTS

#### 2.1 SPRINKLERS

- A. Standard, semi-recessed pendant style, chrome plated finished sprinkler with glass bulb rated for nominal 135°F or 155°F temperature rating for wet pipe system with matching white push on escutcheon plate.



- B. Standard, fully concealed, flush pendant style, chrome plated finished sprinkler with 5 mm glass bulb rated for nominal 155°F temperature rating for sprinkler and 135°F temperature rating for matching white cover plate.
- C. Standard upright style, brass finish with glass bulb rated for nominal 155°F temperature rating for wet pipe system.
- D. Standard, horizontal sidewall style, chrome plated finished sprinkler with glass bulb rated for nominal 135°F or 155°F temperature rating for wet pipe system with chrome plated one piece, flat escutcheon plate.
- E. Quick response, semi-recessed pendant style, chrome plated finished sprinkler with glass bulb rated for nominal 155°F temperature rating for wet pipe system with matching white push on escutcheon plate.
- F. Quick response, fully concealed, flush pendant style, chrome plated finished sprinkler with 3 mm glass bulb rated for nominal 155°F temperature rating for sprinkler and 135°F temperature rating for matching white cover plate.
- G. Quick response, upright style, brass finish with glass bulb rated for nominal 155°F temperature rating for wet pipe system.
- H. Quick response, extended coverage, fully concealed, flush pendant style, chrome plated finished sprinkler with 3 mm glass bulb rated for nominal 155°F temperature rating for sprinkler and 135°F temperature rating for matching white cover plate
- I. Quick response, extended coverage, semi-recessed pendant style, chrome plated finished sprinkler with glass bulb rated for nominal 155°F temperature rating for wet pipe system with matching chrome plated push on escutcheon plate.
- J. Quick response, extended coverage, semi-recessed, horizontal sidewall style, chrome plated finished sprinkler with glass bulb rated for nominal 155°F temperature rating for wet pipe system with matching chrome plated push on escutcheon plate.
- K. Adjustable, standard dry pendant style, chrome plated finished sprinkler with glass bulb holding the seal at the threaded end of the drop nipple by means of a compression screw thru the glass bulb and internal parts onto a sealing spring with a nominal 155°F temperature rating with a matching chrome plated push on escutcheon plate.
- L. Sprinklers located in elevator equipment rooms and shafts shall be upright or side wall type with nominal 200°F temperature rated glass bulbs.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Coordinate work of this Section with other affected work.

### 3.2 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Place pipe runs to minimize obstruction to other work.
- C. Place piping in concealed spaces above finished ceilings.
- D. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- E. Apply masking tape or paper cover to ensure concealed sprinkler cover plates do not receive field paint finish.
- F. Flush entire piping system of foreign matter.
- G. Hydrostatically test entire system.
- H. Require test be witnessed by State Fire Marshal, Owner's insurance underwriter and the Architect.

### 3.3 PAINTING AND FINISHING AND CLEANING

- A. Finish painting (other than factory applied) of fire suppression equipment, and its associated piping, and devices is specified in other sections. Provide touch-up painting for pre-finished products and devices.
- B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish unless otherwise specified.
- C. Piping and equipment: Clean exterior of piping and equipment, removing rust, plaster and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable solvents.
- D. Supports and anchors: Exterior supports and anchors shall be hot dipped galvanized steel with cold galvanized welds.
- E. Cleaning operations are supplemented by detailed instructions for specific systems.

### 3.4 INSTRUCTIONS

- A. Contractor shall provide formal training sessions for all sprinkler/fire suppression systems. Training shall be provided by competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the equipment or system specified. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The length of training session(s) shall be as long as required to review the suppression systems to the Owner's satisfaction with the exception of systems with specified training requirements. There is no limit to the number of attendees on behalf of the Owner.

- B. Training sessions shall be coordinated to provide the Owner with sequential training of all sprinkler systems and equipment. Impromptu training without proper documentation is not acceptable as formal training.
  
- C. The Contractor is solely responsible for initiating, coordinating, and documenting Owner training sessions. The Contractor shall:
  - 1. Schedule the training session with the Owner's representative in writing, allowing sufficient time for the Owner to notify the necessary attendees.
  - 2. Provide a written agenda outlining the systems to be addressed in a given session.
  - 3. Provide a sign in sheet and minutes of the training session.
  - 4. Distribute the above documentation to the Owner and architect as proof of completing formal training.

END OF SECTION

## SECTION 210500 - SPRINKLER BASIC MATERIALS & METHODS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Access Doors.
  - 2. Equipment installation requirements common to equipment sections.

#### 1.2 SUBMITTALS

- A. Product Data: For the following:
  - 1. Access Doors.
- B. Welding certificates.

#### 1.3 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

#### 1.4 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. Protect steel pipe from weather during storage to prevent corrosion and scale build-up.

#### 1.5 COORDINATION

- A. Arrange for pipe spaces, chases, slots, core drilling and openings in the building structure during the progress of construction, to allow for plumbing installation. The Contractor is responsible for providing required penetrations in new and existing structure to accommodate piping.

- B. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND WORKMANSHIP

- A. All equipment and materials shall be new and shall be listed by UL Laboratories Inc. in categories for which standards have been set by that agency. Methods of installation shall be in full accordance with NFPA Standards.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

### 2.3 ACCESS DOORS

- A. Furnish, for installation under appropriate section of the work, access doors at each point required to provide access to concealed equipment, valves, and other devices requiring operation, inspection, adjustment, or maintenance.
- B. Access doors shall be 16 gauge steel, with mounting straps, concealed hangers, and screwdriver locks, designed for the doors to open 180 degrees, minimum.
- C. Access doors installed in fire walls or partitions shall be U.L. labeled to maintain the fire rating of the wall or partition.
- D. Provide prime coat finish for installation in ceilings or painted or unfinished surfaces.
- E. Provide polished chrome plate finish for installation in unpainted finished walls.
- F. Acceptable Manufacturers: Josam, Milcor, Mifab, Wade, Zurn.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install at right angles or parallel. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at required slopes.
- H. Install piping free of sags and bends.
- I. Fire-Barrier Penetrations: Seal all pipe penetrations to maintain indicated fire rating of walls, partitions and floors. Match or exceed the T-rating and F-rating of the construction penetrated in accordance with ASTM E 814 requirements. Fire-stop systems, or assemblies, shall be UL-Classified in accordance with penetrating items and construction penetrated.
- J. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- K. Identify all pipes and valves in accordance with NFPA Standards.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

### 3.3 PAINTING

- A. Painting of sprinkler systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

END OF SECTION



## SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.



## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: **Ratings, characteristics, and features coordinated with and approved by controller manufacturer.**
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION



## SECTION 210553-IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.
  - 5. Warning tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve Schedules: Valve numbering scheme.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Material and Thickness: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2. Letter Color: Black.
  - 3. Background Color: White.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Fasteners: Stainless-steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: Red.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping.
- E. Pipe-Label Colors:
  - 1. Background Color: Safety Red.
  - 2. Letter Color: White.

#### 2.4 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
  - 2. Fasteners: Brass wire-link chain.
  - 3. Valve-Tag Color: Safety Red.
  - 4. Letter Color: White.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

#### 2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Safety Yellow background with black lettering.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.4 PIPE LABEL INSTALLATION

- A. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit a view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 5 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

### 3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
  - 1. Valve-Tag Size and Shape:
    - a. Fire-Suppression Standpipe: 1-1/2 inches, round.
    - b. Wet-Pipe Sprinkler System: 1-1/2 inches, round.
    - c. Dry-Pipe Sprinkler System: 1-1/2 inches, round.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION





## SECTION 211119 - FIRE-DEPARTMENT CONNECTIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exposed-type fire-department connections.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

### PART 2 - PRODUCTS

#### 2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Exposed, projecting, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Number of Inlets: Three.

- J. Escutcheon Plate Marking: Similar to "AUTO SPKR."
- K. Finish: Polished chrome plated.
- L. Outlet Size: NPS 4.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.
- B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION

## SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gauges.

##### B. Related Sections:

1. Section 21 00 00 "Sprinkler General Requirements"
2. Section 21 05 00 "Sprinkler Basic Materials and Methods"
3. Section 21 05 53 "Identification for Fire-Suppression Piping and Equipment"
4. Section 22 11 19 "Backflow Preventers – Double-Check, Backflow-Prevention Assemblies"

#### 1.2 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: Minimum 5.0 psig margin in calculations between the system demand pressure and the available pressure at the required demand flow.
2. Sprinkler Occupancy Hazard Classifications:
  - a. Building Service Areas: Ordinary Hazard, Group 1.
  - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
  - c. General Storage Areas: Ordinary Hazard, Group 2.
  - d. Shell Space, White Box Space, Ordinary Hazard, Group 1.
  - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
  - f. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
  - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
  - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
  - c. Ordinary Hazard, Group 2 Occupancy: 0.2 gpm over 1500-sq.ft. area.
  - d. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.

5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
  - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
  - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
  1. Wiring Diagrams: For power, signal, and control wiring.
- C. Hydraulic calculations.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- E. Operation and maintenance data.

### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  1. NFPA 13, "Installation of Sprinkler Systems."

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. All piping shall be coated on the inside with a factory applied coating known to inhibit corrosion from microbiological organisms, Wheatland's MIC-Shield, or equal.

## 2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E; ASTM A 795/A 795M, Type E. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E. Pipe ends may be factory or field formed to match joining method.
- C. Malleable- or Ductile-Iron Unions: UL 860.
- D. Cast-Iron Flanges: ASME 16.1, Class 125.
- E. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- F. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- G. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anvil International, Inc.
    - b. Shurjoint Piping Products.
    - c. Tyco Fire & Building Products LP.
    - d. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  - 1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

## 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  - 1. Valves shall be UL listed or FM approved.
  - 2. Minimum Pressure Rating: 175 psig.

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Shurjoint Piping Products.
  - d. Tyco Fire & Building Products LP.
  - e. Victaulic Company.
  - f. Viking Corporation.
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

C. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Milwaukee Valve Company.
  - c. NIBCO INC.
  - d. Shurjoint Piping Products.
  - e. Tyco Fire & Building Products LP.
  - f. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch visual indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Anvil International, Inc.
  - b. Fire-End & Croker Corporation.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Potter Roemer.
  - f. Tyco Fire & Building Products LP.
  - g. Victaulic Company.

2.6 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  - a. AGF Manufacturing Inc.
  - b. Reliable Automatic Sprinkler Co., Inc.
  - c. Tyco Fire & Building Products LP.
  - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

B. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following
  - a. AGF Manufacturing Inc.
  - b. Tyco Fire & Building Products LP.
  - c. Victaulic Company.
  - d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.



3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

## 2.7 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Globe Fire Sprinkler Corporation.
  2. Reliable Automatic Sprinkler Co., Inc.
  3. Tyco Fire & Building Products LP.
  4. Viking Corporation.
- B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
  2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
  3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
1. Nonresidential Applications: UL 199.
  2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" or "Intermediate" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
1. Chrome plated.
  2. Bronze.
  3. Painted.

## 2.8 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Exposed, projecting, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.

- G. Escutcheon Plate: Round, brass, wall type.
- H. Outlet: Back, with pipe threads.
- I. Number of Inlets: 2 minimum.
- J. Escutcheon Plate Marking: Similar to "AUTO SPRINKLER"
- K. Finish: Polished chrome plated, rough brass or bronze, rough chrome plated. Coordinate with architect finish.
- L. Outlet Size: NPS 4.

## 2.9 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION

- A. Standard: UL 405.
- B. Type: Flush, for wall mounting.
- C. Pressure Rating: 175 psig minimum.
- D. Body Material: Corrosion-resistant metal.
- E. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
- F. Caps: Brass, lugged type, with gasket and chain.
- G. Escutcheon Plate: Rectangular, brass, wall type.
- H. Outlet: With pipe threads.
- I. Body Style: Horizontal, square, vertical. Coordinate body with architect.
- J. Number of Inlets: 2 minimum.
- K. Outlet Location: Back or top.
- L. Escutcheon Plate Marking: Similar to "AUTO SPRINKLER"
- M. Finish: Polished chrome plated, rough brass or bronze, rough chrome plated. Coordinate with architect finish.
- N. Outlet Size: NPS 4.

## 2.10 ALARM DEVICES

- A. Alarm-device types to match piping and equipment connections.
- B. Water-Motor-Operated Alarm:

1. Standard: UL 753.
  2. Type: Mechanically operated, with Pelton wheel.
  3. Alarm Gong: Cast aluminum with red-enamel factory finish.
  4. Components: Shaft length, bearings, and sleeve to suit wall construction.
  5. Inlet: NPS 3/4.
  6. Outlet: NPS 1 drain connection.
- C. Electrically Operated Notification Appliances:
1. Electric Bell:
    - a. Standard: UL 464.
    - b. Type: Vibrating, metal alarm bell.
    - c. Size: 10-inch diameter.
    - d. Voltage: 120V ac, 60Hz, 1 phase.
    - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
  2. Strobe/Horn:
    - a. Standard: UL 464.
    - b. Tone: Selectable, steady, Temporal-3 (T-3) in accordance with ISO 8201 and ANSI/ASA S3.41, 2400 Hz, electromechanical, broadband.
    - c. Voltage: 120 V ac, 60 Hz.
    - d. Effective Intensity: 110 cd.
    - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox. White letters on housing identifying device as for "Fire."
    - f. Sign, Integrated: Mount between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Housing to be shaped to cover surface-mounted weatherproof backbox. Sign is to consist of white lettering on red plastic identifying it as a "Sprinkler Fire Alarm" and instructing viewers to call 911, police, or fire department.
- D. Water-Flow Indicators:
1. Standard: UL 346.
  2. Water-Flow Detector: Electrically supervised.
  3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  4. Type: Paddle operated.
  5. Pressure Rating: 250 psig.
  6. Design Installation: Horizontal or vertical.
- E. Pressure Switches:
1. Standard: UL 346.
  2. Type: Electrically supervised water-flow switch with retard feature.
  3. Components: Single-pole, double-throw switch with normally closed contacts.
  4. Design Operation: Rising pressure signals water flow.
- F. Valve Supervisory Switches:
1. Standard: UL 346.
  2. Type: Electrically supervised.
  3. Components: Single-pole, double-throw switch with normally closed contacts.

4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 2.11 PRESSURE GAUGES

- A. Standard: UL 393.
- B. Pressure Gauge Range: 0-250 psig, minimum.
- C. Label: Include "WATER" label on dial face.

### PART 3 - EXECUTION

#### 3.1 WATER-SUPPLY CONNECTIONS

#### 3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- E. Install sprinkler piping with drains for complete system drainage.
- F. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- G. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- H. Fill sprinkler system piping with water.

#### 3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

- B. 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 pipes, tubes, and fittings before assembly.
- D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- F. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection.

### 3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

### 3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13. SEE SECTION 21 05 53 "IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT".

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
- C. The sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.8 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

### 3.9 PIPING SCHEDULE

- A. Wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
  - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron or malleable iron threaded fittings; and threaded joints.
- B. Wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be the following:
  - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 2. Schedule 10, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- C. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends, cast-iron threaded fittings, and threaded joints.

3.10 SPRINKLER SCHEDULE

- A. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Pendent, recessed, flush, and concealed sprinklers as indicated.
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Spaces Subject to Freezing: Upright sprinklers.
  
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  - 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  - 3. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

END OF SECTION

## SECTION 213113- ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. In-line fire pumps.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fire pump, from manufacturer.
- B. Source quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire pumps to include, in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 20.
- B. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.



## 2.2 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

- A. Description: Factory-assembled and -tested fire-pump and driver unit.
- B. Base: Fabricated and attached to fire-pump and driver unit, with reinforcement to resist movement of pump during seismic events when base is anchored to building substrate.
- C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

## 2.3 IN-LINE FIRE PUMPS

- A. Pump:
  - 1. Standard: UL 448, for in-line pumps for fire service.
  - 2. Casing: Radially split case, cast iron, with ASME B16.1 pipe-flange connections.
  - 3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
  - 4. Wear Rings: Replaceable bronze.
  - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
    - a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    - b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.
  - 6. Mounting: Pump and driver shaft is vertical, with motor above pump and pump on base. Motor and pump rotating assembly shall be removable from top without removing the pump casing from the piping.
- B. Coupling: None or rigid.
- C. Driver:
  - 1. Standard: UL 1004A.
  - 2. Type: Electric motor; NEMA MG 1, polyphase Design B.

## 2.4 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

1. Verification of Performance: Rate fire pumps according to UL 448.
- B. Fire pumps will be considered defective if they do not pass tests and inspections.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of fire pumps.
- B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.
- B. Equipment Mounting:
  1. Install fire pumps on cast-in-place concrete equipment bases.
- C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.
- D. Support piping and pumps separately, so weight of piping does not rest on pumps.
- E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."
- F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Section 211313 "Wet-Pipe Sprinkler Systems."
- G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.
- H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.
- I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

### 3.3 ALIGNMENT

- A. Align end-suction pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.
- B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.
- C. Align piping connections.
- D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

### 3.4 CONNECTIONS

- A. Comply with requirements for piping and valves specified in Section 211313 "Wet-Pipe Sprinkler Systems." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to pumps and equipment to allow service and maintenance.
- C. Connect fire pumps to their controllers.

### 3.5 IDENTIFICATION

- A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.
- C. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

END OF SECTION



## SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vertical, multistage, pressure-maintenance pumps.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For pumps, accessories, and specialties.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 VERTICAL, MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

- A. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.
- B. Pump Construction:
  - 1. Barrel: Stainless steel.
  - 2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.

3. Pump Head/Motor Mount: Cast iron.
  4. Impellers: Stainless steel, balanced, and keyed to shaft.
  5. Pump Shaft: Stainless steel.
  6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
  7. Wear Rings: Teflon.
  8. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
  9. Chamber-Base Bearing: Tungsten carbide.
  10. O-Rings: EPDM.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
- E. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet long.
- F. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

## 2.2 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 210513 "Common Motor Requirements for Fire Suppression Equipment."
1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.
- B. Equipment Mounting:
1. Install multistage, pressure-maintenance pumps according to HI 1.4.
    - a. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
    - b. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
    - d. Attach pumps to equipment base using anchor bolts.
    - e. Shim pumps as needed to make them level.

2. Install isolation valves in both inlet and outlet pipes near the pump. Comply with requirements for valves specified in Section 211313 "Wet-Pipe Sprinkler Systems."

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

### 3.3 ADJUSTING

- A. Lubricate pumps as recommended by the manufacturer.
- B. Set field-adjustable pressure-switch ranges as indicated.

END OF SECTION



## SECTION 220000 – PLUMBING GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section as well as the Drawing and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 – General Sections included in Division 22 Specifications are for plumbing and related work. Coordinate with plans and other specifications sections.

#### 1.2 RELATED DOCUMENTS

SECTION 220000 – PLUMBING GENERAL REQUIREMENTS  
SECTION 220500 – PLUMBING BASIC MATERIALS AND METHODS  
SECTION 220513 – COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT  
SECTION 220523 – GENERAL DUTY VALVES FOR PLUMBING PIPING  
SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING  
SECTION 220719 – PLUMBING PIPING INSULATION  
SECTION 221116 - DOMESTIC WATER PIPING  
SECTION 221119 – DOMESTIC WATER PIPING SPECIALTIES  
SECTION 221316 - SANITARY WASTE AND VENT PIPING  
SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES  
SECTION 221413 – STORM DRAINAGE PIPING  
SECTION 221423 – STORM DRAINAGE PIPING SPECIALTIES  
SECTION 221449 – NATURAL GAS PIPING  
SECTION 223400 – FUEL FIRED, DOMESTIC WATER HEATERS  
SECTION 224000 - PLUMBING FIXTURES

#### 1.3 WORK INCLUDED

- A. The work covered by this Division of the Specifications consists of furnishing all plant, labor, equipment, supervision, appliances, and materials, and in performing all operations in connection with the plumbing systems complete and in strict accordance with this Division of the Specifications and the applicable drawings.

#### 1.4 COORDINATION OF WORK

- A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships which must be established within the plumbing work, and in its interface with other work, including electrical and mechanical work, and that such establishment is the exclusive responsibility of the Contractor.
- B. Advise other trades of openings required in their work for the subsequent move-in of large equipment.

- C. Submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.
- D. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- E. Verify all dimensions by field measurements.
- F. Arrange for chases, slots, and openings in other building components to allow for installation.
- G. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- H. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the installation areas.
- I. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials. Comply with Division 1.
- J. Install equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- K. Coordinate the installation of materials and equipment above ceilings with suspension system, mechanical and electrical equipment and systems, and structural components.
- L. Contractor shall visit the site before bidding to familiarize himself with conditions under which he will have to perform his Contract.

#### 1.5 CODES AND STANDARDS

- A. Workmanship, material and equipment shall be in accordance with Specifications and Drawings, and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements.

#### 1.6 ELECTRICAL WORK

- A. Refer to Division 26 for all electrical work as it pertains to work specified in this section.

#### 1.7 WORKMANSHIP

- A. Install all materials and components of the work in accordance with instructions of the manufacturer following the best modern construction practices and conforming to the Contract Documents. Workmanship shall be first class, in both function and appearance, whether finally concealed or exposed and shall be performed by experienced workmen skilled in the type of work. As practicable, the lines of all exposed components of the system shall be perpendicular or parallel to the lines of the building.

## 1.8 DRAWINGS

- A. Contract Drawings and details are shown to limit and explain structural conditions, requirements, and manner of erecting work. Drawings are intended to convey the scope of work and indicate general arrangements of equipment and piping and approximate sizes and locations of equipment and devices. Trades shall follow these drawings in laying out their work, check general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.
- B. It may be necessary to shift pipes or devices and this is permissible, and may be required under the general contract, but all such changes must be referred to the Architect for approval. Where rearrangement of piping or equipment is required, Contractor shall prepare and submit approval drawings of the proposed arrangement.
- C. Where the Contractor is not certain about the method of installation, he shall ask for details. Lack of details, not requested, will not be an excuse for improper installation, and any such work must be corrected.

## 1.9 SHOP DRAWINGS AND DATA TO BE SUBMITTED

- A. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract Documents. Clearly indicate on submitted data the manufacturer's name, piece number, equipment capacity, and other applicable technical data. Refer to individual sections for specific requirements.
- B. Corrections or comments made on shop drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents, Plans and Specifications. Shop Drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the contract documents. Review of Shop Drawings shall not relieve the Contractor from responsibility for confirming and correlating all quantities and dimensions, coordinating work with that of all other trades, and performing work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviation from Plans and Specifications. Shop Drawings must be accompanied by signed statement from Contractor, stating that he has reviewed the submittal and checked it for compliance.
- C. Any item not specified herein but submitted as a substitute for the specified item shall be accompanied by manufacturer's documentation starting/illustrating the following applicable information in addition to the specific information requested in other sections.
  - 1. Dimensions/weight.
  - 2. Electrical ratings-voltage, amperage, short circuit capability, etc.
  - 3. Construction - gauge of steel/aluminum, paint finish/application method, color, NEMA type, etc.
  - 4. Warranty.

## 1.10 INSTRUCTIONS

- A. Contractor shall provide formal training sessions for all plumbing systems. Training shall be provided by competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements of the

equipment or system specified. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The length of training session(s) shall be as long as required to review the plumbing systems to the Owner's satisfaction with the exception of systems with specified training requirements. There is no limit to the number of attendees on behalf of the Owner.

- B. Training sessions shall be coordinated to provide the Owner with sequential training of all plumbing systems and equipment. Impromptu training without proper documentation is not acceptable as formal training.
- C. The Contractor is solely responsible for initiating, coordinating, and documenting Owner training sessions. The Contractor shall:
  - 1. Schedule the training session with the Owner's representative in writing, allowing sufficient time for the Owner to notify the necessary attendees.
  - 2. Provide a written agenda outlining the systems to be addressed in a given session.
  - 3. Provide a sign in sheet and minutes of the training session.
  - 4. Distribute the above documentation to the Owner and architect as proof of completing formal training.

#### 1.11 OPERATING AND MAINTENANCE MANUALS

- A. Bind in loose leaf binders with the words, "Operating and Maintenance Manual" and the project identification imprinted on the cover. Prepare three complete sets of records for the Owner, with table of contents, index, and tabbed section dividers.
- B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals:
- C. Copies of warranties and guarantees on each piece of equipment installed.
  - 1. Plumbing.
  - 2. Wiring and control diagrams.
  - 3. Shop Drawings.
  - 4. Operating instructions for:
    - a. Plumbing Systems
    - b. Recommended maintenance procedures.
- D. Submit the manuals for approval at approximately 85 percent job completion. Each manual shall consist of:
  - 1. Complete description of each item of equipment and apparatus furnished and installed - including ratings, capacities, and characteristics.
  - 2. Fully detailed parts list, including all numbered parts of each item of equipment and apparatus furnished and installed.
  - 3. Manufacturer's printed instructions describing operation, servicing, maintenance and repair of each item of equipment and apparatus.
  - 4. Provide serial and model numbers for all equipment.

#### 1.12 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications, adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of materials and equipment to minimize construction site congestion.

#### 1.13 GUARANTEES

- A. Contractor shall guarantee all materials, workmanship, and equipment furnished under Division 22 for a period of one (1) year after the date of final acceptance or beneficial use by the Owner, whichever date is the earliest.

### PART 2 - PRODUCTS

#### 2.1 AVAILABLE MANUFACTURERS

- A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed Specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.
- B. The Drawings indicate specified products physically arranged in the spaces, as catalogued by Specific manufacturers, generally as listed in the equipment schedules.
- C. Listed "Acceptable Manufacturers" are those considered capable of manufacturing products conforming to detailed Specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted," "approved," "prior approval," or any other such connotation.

#### 2.2 FLAME-SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

- A. Materials and adhesives used throughout the plumbing and electrical systems for insulation, acoustical lining, filters, ducts, flexible connections, and jackets or coverings regardless of kind, or for piping or conduit system components, shall have a flame-spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. If such materials are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame-spread rating not over 25 and a smoke developed rating not higher than 50.
- B. "Flame-Spread Rating" and "Smoke Developed Rating" shall be as determined by the "Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 225, ASTM E84,

Underwriter's Laboratories, Inc., Standard." Such materials are listed in the Underwriter's Laboratories, Inc. "Building Materials List" under the heading "Hazard Classification (Fire)."

### 2.3 AUXILIARY STRUCTURAL SUPPORTS

- A. Provide auxiliary structural supports as necessary to support plumbing systems from the building structure. Supporting members shall be metal strut framing or standard structural shapes, designed to support imposed loads with a working stress no greater than 25 percent of ultimate stress values of the members, and articulation with the building structure without exceeding structural limitations at the point of attachment to the building structure.

### 2.4 SPECIAL TOOLS

- A. Furnish a set of special tools and devices required for the proper maintenance of the major pieces of equipment and install on adequate tool board. This shall include only tools which cannot normally be purchased "over-the-counter" at hardware stores.

### 2.5 EQUIPMENT GUARDS

- A. Provide equipment with exposed moving parts with belt guards, coupling guards, fan guards or other enclosures as necessary for personnel safety.

## PART 3 - EXECUTION

### 3.1 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Protect equipment and materials from physical damage, water damage and deterioration after it is delivered to the project, and during the installation.
- B. The equipment shall be kept clean. Motors and electrical devices shall be covered with suitable materials to prevent dirt or dust accumulation within equipment. Machinery and devices shall be properly oiled and maintained to prevent rusting and deterioration.
- C. Repair scratches, mars, or paint deterioration.

### 3.2 MATERIAL DAMAGE

- A. The Contractor shall immediately report in writing to the Owner and design professional any incident involving equipment or material damage including rain water damage, pipe leaks, physical damage, etc.
- B. At a minimum the report shall include the areas and extent of damage and proposed resolution.
- C. Water damaged materials shall be replaced with new materials without exception.

### 3.3 EXCAVATION AND BACKFILL

- A. Perform excavation and backfill required for the installation of underground pipe, ducts, equipment, and devices in accordance with other divisions of this Specification relating to such work. Carefully check for existing underground services before using power equipment for excavation.
- B. Trenches shall be wide enough for proper installation of the pipe. Grade the ditch bottom for proper slope and provide bell holes to allow the full bearing of the pipe barrel. Comply with all health and safety regulations relating to ditching.
- C. De-water to extent necessary to keep trenches dry and to provide proper compaction under all pipes. Continue de-watering operation until system has been tested, approved, backfilled, and compacted.
- D. Excavate 6" below the pipe and fill with sand to pipe grade.
- E. No excavation shall be under or near footings without approval of the Architect.
- F. Backfill trenches with clean dirt or sand. Take care not to disturb the pipe grade or alignment. Compact around and under the pipe carefully. The fill shall be compacted in 6" layers with a power tamper to achieve 95% compaction. Clean up around the ditch area to remove trash and any excess dirt.

### 3.4 HANGERS AND SUPPORTS FOR UNDERGROUND PIPING

- A. Provide stainless steel hanger rods to support all soil and waste drainage piping installed below building slab. Rods shall be minimum 1/4" diameter, type 316 stainless steel spaced at 5'-0" maximum spacing for cast iron piping and 4'-0" maximum spacing for PVC piping with hanger occurring at all pipe joints. The rod shall be bent into the center of the slab and span over a minimum two steel reinforcing bars. Additional, provide support at each joint or fitting and at each "P-trap" and closet bend

### 3.5 EQUIPMENT AND PIPE SPACE

- A. The Drawings indicate specified products physically arranged in the spaces, as catalogued by specific manufacturers, generally as listed in the equipment schedules.
- B. Drawings show pipe diagrammatically.
- C. Adhere to Drawings as closely as possible in layout of work.
- D. Vary run of piping, run and make offsets during progress of work as required to meet structural and other interferences per reviewed shop drawings.
- E. Install piping above ceilings and in furred spaces. Run exposed piping parallel to or at right angles to building walls.
- F. Keep horizontal lines as high as practicable.

- G. Conform to ceiling heights established on the Drawings with adequate clearance for light fixtures.
- H. Motor actuators shall be oriented and installed to allow for easy removal and access.

### 3.6 PAINTING AND FINISHING AND CLEANING

- A. Finish painting (other than factory applied) of plumbing equipment, and its associated piping and devices is specified in other sections. Provide touch-up painting of pre-finished plumbing products.
- B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish unless otherwise specified.
- C. Piping and Equipment: Clean exterior of piping and equipment, removing rust, plaster and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable solvents.
- D. Supports and Anchors: Exterior supports and anchors shall be hot dipped galvanized steel with cold galvanized welds.
- E. Motors, Pumps and other items with factory finish: Remove grease and oil and leave surfaces clean and polished.
- F. Plumbing Fixtures: Clean and polish fixtures immediately prior to final inspection.
- G. Cleaning operations are supplemented by detailed instructions for specific systems.

END OF SECTION



## SECTION 220500 - PLUMBING BASIC MATERIALS & METHODS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Dielectric fittings.
  - 3. Labels and nameplates.
  - 4. Sleeves.
  - 5. Access Doors.
  - 6. Concrete.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.

#### 1.2 SUBMITTALS

- A. Product Data: For the following
  - 1. Dielectric fittings.
  - 2. Labels and nameplates.
  - 3. Sleeves.
  - 4. Access Doors.
- B. Welding certificates.

#### 1.3 QUALITY ASSURANCE

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

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver 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. Protect steel pipe from weather during storage to prevent corrosion and scale build-up.
- C. Store PVC pipes such that they are protected from direct sunlight. Support to prevent sagging.

## 1.5 COORDINATION

- A. Arrange for pipe spaces, chases, slots, core drilling and openings in the building structure during progress of construction, to allow for plumbing installation. The Contractor is responsible for providing required penetrations in new and existing structure to accommodate piping.
- B. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces.

## PART 2 - PRODUCTS

### 2.1 MATERIALS AND WORKMANSHIP

- A. All equipment and materials shall be new and shall be listed by UL Laboratories Inc. in categories for which standards have been set by that agency. Methods of installation shall be in full accordance with the latest and best electrical and mechanical engineering practices. Pressure vessels, as called for by respective codes, shall be stamped ASME and National Board Commission.

### 2.2 PIPE, TUBE, AND FITTINGS

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

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated. Full-Face type for flat-face, Class 125, flanges and narrow-face type for raised face, Class 250, flanges.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

- E. Welding Filler Metals: Comply with AWS D10.12.
- F. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 2. PVC to ABS Piping Transitions: ASTM D 3138.

#### 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.

#### 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 minimum working pressure at 180 degrees F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 degrees F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.

#### 2.6 LABELS AND NAMEPLATES

- A. Pipe Labels:
  - 1. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
  - 2. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
  - 3. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
  - 4. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
    - a. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
    - b. Lettering Size: At least 1-1/2 inches high.
- B. Stencils:
  - 1. Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for equipment labels, and similar operational instructions.

- a. Stencil Material: Aluminum or Type 304 stainless steel.
  - b. Stencil Paint: Exterior, gloss enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - c. Identification Paint: Exterior enamel in colors according to ASME A13.1 unless otherwise indicated.
- C. Valve Tags:
1. Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  2. Tag Material: Brass, 0.032-inch or Type 304 stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  3. Fasteners: Brass wire-link or S-hook.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve, normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
- E. Valve-tag schedule shall be included in operation and maintenance data.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

## 2.8 ACCESS DOORS

- A. Furnish, for installation under appropriate section of the work, access doors at each point required to provide access to concealed equipment, valves, and other devices requiring operation, inspection, adjustment, or maintenance.
- B. Access doors are specified in Section 083113.
- C. Access doors installed in fire walls or partitions shall be U.L. labeled to maintain the fire rating of the wall or partition.

## 2.9 CONCRETE

- A. All formed and poured in place concrete work shall be provided under Division 3. All concrete equipment bases shall be provided under this Section.
- B. The Contractor shall furnish all required templates and dimensional drawings for housekeeping pads.
- C. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch 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. Use 3000-psi, 28-day compressive-strength

#### 2.10 GROUT

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

### PART 3 - EXECUTION

#### 3.1 PLUMBING DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

#### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install at right angles or parallel. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.

- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations or walls, ceilings and floors in exposed areas.
- M. Install sleeves for pipes passing through gypsum-board partitions. Cut sleeves to length for mounting flush with both surfaces. Extend sleeves as required to accommodate ring clamps if specified.
- N. Fire-Barrier Penetrations: Seal all pipe penetrations to maintain indicated fire rating of walls, partitions and floors. Match or exceed the T-rating and F-rating of the construction penetrated in accordance with ASTM E 814 requirements. Fire-stop systems, or assemblies, shall be UL-Classified in accordance with penetrating items and construction penetrated.
- O. Verify final equipment locations prior to roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Q. Identify all pipes and valves. Pipes shall be identified every 20 feet on center and at each side of a wall or partition.
- R. Expansion and Contraction of Piping:
  - 1. Allowance shall be made throughout for expansion and contraction of pipe. Horizontal runs of pipe with expansion loops or joints shall be anchored to the supporting construction to force expansion toward the expansion joints or loops. Horizontal runs of piping without expansion joints or loops, over 50 feet in length, shall be anchored in the middle of the run to force the expansion evenly toward the ends.
  - 2. All pipes shall be installed so that they may contract or expand freely without damage to any other work or injury to itself. Any swing joints, expansion joints, or bends necessary shall be installed whether shown or not.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers and solvent cements.
  - 2. PVC Non-pressure Piping: Join according to ASTM D 2855.
  - 3. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D 3138 Appendix.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. 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 to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slopes.

- E. Equipment shall be installed at the more stringent elevation required by the local authority having jurisdiction or Owner's insurer. The Contractor is responsible for verifying the benchmark and setting the proper elevation. Provide supplemental structure, or increase equipment base height, to achieve the required elevation. Provide permanently mounted access ladder and fenced, or railing, service area for installation greater than 3'-0" above finished grade.

### 3.6 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.7 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 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 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.

### 3.8 GROUTING

- A. Mix and install grout for mechanical 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 220500



## SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

#### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.

#### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

## 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
  - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
  - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
  - 2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION



## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.

##### B. Related Sections:

1. Section 220500 "Plumbing Basic Materials and Methods" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 220719 "Plumbing Piping Insulation" for valves applicable, shall be insulated and provided the appropriate stem extension.
4. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
5. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.
6. Section 221449 "Natural Gas Piping" for valves applicable only to this piping.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- ##### A. ASME Compliance:
- ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- 
- ##### B. NSF Compliance:
- The lead contents of pipes, fittings, valves and fixtures used to supply potable water throughout the domestic water system shall meet the requirements of NSF 61-G and ANSI 372 shall not contain more than a weighted average of 0.25% lead when used with respect to the wetted surfaces of pipes, pipe fittings, valves, plumbing fittings and fixtures.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

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

- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Hand-lever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
  - 2. Solder Joint: With sockets according to ASME B16.18.
  - 3. Threaded: With threads according to ASME B1.20.1.

## 2.2 BRASS BALL VALVES

- A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Crane Co.; Crane Valve Group; Jenkins Valves.
    - b. Hammond Valve.
    - c. Jamesbury; a subsidiary of Metso Automation.
    - d. Kitz Corporation.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.
    - g. Red-White Valve Corporation.
  - 2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Forged brass.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Brass.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.



## 2.3 BRONZE BALL VALVES

### A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corporation.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

## 2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

### A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Crane Co.; Crane Valve Group; Jenkins Valves.
  - c. DeZurik Water Controls.
  - d. Hammond Valve.
  - e. Kitz Corporation.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corporation.
2. Description:
  - a. Standard: MSS SP-67, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
  - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

- e. Seat: EPDM.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

## 2.5 BRONZE SWING CHECK VALVES

### A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Jenkins Valves.
  - b. Hammond Valve.
  - c. Kitz Corporation.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Red-White Valve Corporation.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

### B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Jenkins Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corporation.
2. Description:
  - a. Standard: MSS SP-80, Type 4.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: PTFE or TFE.

## 2.6 IRON SWING CHECK VALVES

### A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Crane Co.; Crane Valve Group; Jenkins Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corporation.
2. Description:
  - a. Standard: MSS SP-71, Type I.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Clear or full waterway.
  - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
  - e. Ends: Flanged.
  - f. Trim: Bronze.
  - g. Gasket: Asbestos free.

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

### 3.2 ADJUSTING

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

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
  2. Throttling Service: Ball or butterfly valves.
  3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
  4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
  5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
  6. For Steel Piping, NPS 5 and Larger: Flanged ends.

#### 3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  2. Ball Valves: Two piece, full port, brass or bronze with brass or bronze trim.
  3. Bronze Swing Check Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
  2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
  3. Iron Swing Check Valves: Class 125, metal seats.

END OF SECTION

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

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fastener systems.
  - 4. Pipe positioning systems.
  - 5. Equipment supports.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Equipment supports.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

#### A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

#### B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 2.4 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

### 2.5 EQUIPMENT SUPPORTS

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

## 2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- G. Install hangers and supports to allow controlled thermal 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.
- H. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- 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 to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
  - 1. Install MSS SP-58, Type 40, protective shields on insulated piping. Shields shall span an arc of 180 degrees.
  - 2. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
- L. PEX Horizontal Piping: PEX piping shall be continuously supported using the manufacturer's 23 gage, galvanized steel channel pipe support that is strapped to the piping with the manufacturer supplied support straps.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.



### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use protective shields for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 8.
  - 2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.

3. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 8, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 8.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 8 if longer ends are required for riser clamps.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. C-Clamps (MSS Type 23): For structural shapes.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
- O. Comply with MSS SP-69 and manufacturer's recommendations for distance between pipe supports

END OF SECTION

## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic hot-water and hot water return piping.
  - 2. Domestic cold-water piping.
  - 3. Supplies and drains for handicap-accessible lavatories and sinks.
  - 4. Sanitary sewer piping receiving cold condensate from fixtures or equipment.
  - 5. Storm drainage piping (roof drain body and horizontal piping down stream of drain body).

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000-Degree Pipe Insulation.
    - c. Manson Insulation Inc.; Alley-K.
    - d. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- E. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in performing insulation to cover elbows and tees.
- F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.

### 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Adhesive Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.4 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.

5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

## 2.5 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. McGuire Manufacturing.
  - b. Plumberex.
  - c. Truebro; a brand of IPS Corporation.
  - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation material jackets and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- H. Install insulation with least number of joints practical.
- I. Apply adhesives at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- J. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Fire-stopping" for fire-stopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Fire-stopping."

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves and Unions:
  - 1. Install insulation over fittings, valves, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts.
  5. Insulate unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  6. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When union covers are made from sectional pipe insulation, extend insulation from union at least two times the insulation thickness over adjacent pipe insulation on each side of union. Secure cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner, except divide the two-part section on the vertical center line of valve body.

### 3.5 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. For insulation with factory-applied jackets secure tabs with additional adhesive as recommended by insulation material manufacturer.
- B. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- C. Insulation Installation on Valves and Pipe Specialties:



1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

#### A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.7 FIELD QUALITY CONTROL

#### A. Perform tests and inspections.

#### B. Tests and Inspections:

1. Inspect pipe, fittings and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, and three locations of threaded valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

#### C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.8 PIPING INSULATION SCHEDULE, GENERAL

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

### 3.9 INDOOR PIPING INSULATION SCHEDULE

#### A. Domestic Cold Water (Copper Piping): Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. Cold water drops in walls serving fixtures do not need to be insulated.

- B. Domestic Cold Water (PP-R and PEX Piping):
  - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
  - 2. All piping within return air plenum shall be insulated.
  
- C. Domestic Hot Water/Hot Water Return (Copper Piping): Insulation shall be the following:
  - 1. Mineral-Fiber, Preformed Pipe Insulation, 1 inch thick.
  - 2. All hot water and hot water return piping shall be insulated.
  
- D. Rigid Domestic Hot Water/Hot Water Return (PP-R and PEX Piping): Insulation shall be the following:
  - 1. Mineral-Fiber, Preformed Pipe Insulation, 1/2 inch thick or flexible elastomeric insulation, 1/2 inch thick.
  - 2. Hot water branch piping serving individual fixtures does not require insulation.
  - 3. All hot water piping within the return air plenum shall be insulated.
  
- E. Rolled Domestic Hot Water (PEX Piping):
  - 1. Flexible Elastomeric Insulation, 1/2 inch thick.
  - 2. Hot water branch piping serving individual fixtures does not require insulation.
  - 3. All hot water piping within the return air plenum shall be insulated.
  
- F. Sanitary Waste Piping Receiving Cold Condensate: Insulation shall be one of the following:
  - 1. Flexible Elastomeric Insulation, 1/2 inch thick.
  - 2. Mineral-Fiber Blanket Insulation: 0.75 pounds per cubic foot, 1-1/2" thickness.
  
- G. PVC waste and vent piping in ceiling plenum space: Insulation shall be one of the following:
  - 1. Mineral-Fiber Blanket Insulation: 0.75 pounds per cubic foot, 1" thickness with ASJ.
  
- H. Storm Drain Piping: Insulation shall be the following:
  - 1. Mineral-Fiber Blanket Insulation: 0.75 pounds per cubic foot, 1-1/2" thickness.
  - 2. Insulate drain body and horizontal piping downstream of drain body including transition from horizontal to vertical piping (downspout).

END OF SECTION

## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

#### 1.3 QUALITY ASSURANCE

- A. NSF Compliance: The lead contents of pipes, fittings, valves and fixtures used to supply potable water throughout the domestic water system shall meet the requirements of NSF 61-G and ANSI 372 shall not contain more than a weighted average of 0.25% lead when used with respect to the wetted surfaces of pipes, pipe fittings, valves, plumbing fittings and fixtures.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

#### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

- F. Copper Unions:
  - 1. MSS SP-123.
  - 2. Cast-copper-alloy, hexagonal-stock body.
  - 3. Ball-and-socket, metal-to-metal seating surfaces.
  - 4. Solder-joint or threaded ends.
  
- G. Copper Press Fittings:
  - 1. EPDM Seals
  - 2. ASME B16.51 Certified
  - 3. International Plumbing Code Certified for Potable Water
  - 4. NSF 61 Certified for drinking water
  - 5. Rated for -22 deg. F to +248 deg F
  - 6. Rated for 200 PSI

## 2.3 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 876 and ASTM 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1960, cold expansion fittings and reinforcing rings and matching PEX tube dimensions.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 876; with plastic or corrosion-resistant-metal valve for each outlet.

## 2.4 PP-R PIPE AND FITTINGS

- A. Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
- B. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.
- C. Fittings shall be installed according to the manufacturer's instructions.

## 2.5 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
  2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## 2.6 TRANSITION FITTINGS

- A. General Requirements:
1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hart Industries International, Inc.
    - b. Jomar International.
    - c. Matco-Norca.
    - d. Watts; a division of Watts Water Technologies, Inc.
    - e. Wilkins; a Zurn company.
  2. Standard: ASSE 1079.
  3. Pressure Rating: 125 psig minimum at 180 degrees F.
  4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Matco-Norca.
  - b. Watts; a division of Watts Water Technologies, Inc.
  - c. Wilkins; a Zurn company.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 degrees F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Non-conducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Grinnell Mechanical Products; Tyco Fire Products LP.
  - b. Matco-Norca.
  - c. Precision Plumbing Products, Inc.
  - d. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 degrees F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 220000 "Plumbing General Requirements" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install PP-R pipe materials and joining methods as follows:
  - 1. Polypropylene (PP-R) piping in SDR 7.4, 11, or 17.6 based on the required minimum pressure rating and use temperature, in accordance with manufacturer's instructions and ASTM F2389.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level and plumb.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. 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.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping to permit valve servicing.
- K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.

- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install rolled PEX piping with loop at each change of direction of more than 90 degrees.
- P. Install rigid PEX piping for all horizontal piping, excluding runouts to fixtures downstream of PEX manifolds. Support piping without sags via hangers or continuous saddle. Rigid piping shall run parallel and perpendicular to building walls.
- Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump.
- R. Install thermostats in hot-water circulation piping.
- S. Install thermometers on inlet and outlet piping from each water heater.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
- V. Install rubber protective sleeves between copper piping and ferrous steel hangers.

### 3.3 JOINT CONSTRUCTION

- A. Remove scale, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- C. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- F. Joints for PEX Piping: Join according to ASTM F 1807.
- G. Joints for PP-R Piping: Install fittings and joints using socket-fusion, electro-fusion, or butt-fusion as applicable for the fitting type. All fusion-weld joints shall be made in accordance with the pipe and fitting manufacturer's specifications and product standards.



1. Fusion-weld tooling, welding machines, and electrofusion devices shall be as specified by the pipe and fittings manufacturer.
  2. Prior to joining, the pipe and fittings shall be prepared in accordance with ASTM F 2389 and the manufacturer's specifications.
  3. Joint preparation, setting and alignment, fusion process, cooling times and working pressure shall be in accordance with the pipe and fitting manufacturer's specifications.
- H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.4 TRANSITION FITTING INSTALLATION

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

### 3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Vertical Piping: MSS Type 8 or 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs:
    - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the maximum horizontal spacing and minimum rod diameters as recommended by MSS SP-69 and manufacturer's written instructions.
- E. Install supports for vertical copper tubing every 10 feet.

- F. Install hangers for PEX piping in accordance with manufacturer's requirements and as required to prevent sagging.
- G. Install hangers for vertical PEX piping every 48 inches.
- H. Install hangers for PP-R piping in accordance with manufacturer's requirements and as required to prevent sagging.
- I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. All PEX piping wall terminations shall be equipped with PEX copper stub outs with anchor plates or stud supports. Support stub out such that angle stop is immovable.
- C. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- D. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- E. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
  - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220500 "Plumbing Basic Materials and Methods."

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:

- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - f. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  5. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Repeat procedures if biological examination shows contamination.
    - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be the following:
1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- D. Under-building-slab, domestic water piping, NPS 3/4 and smaller, shall be the following:
1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
  2. Pressed fittings not allowed for underground use.
  3. PEX tube, fittings for PEX tube; no joints.

- E. Aboveground domestic water piping NPS 2-1/2 and larger shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed, or soldered joints.
  2. Pressed fitting not allowed for Copper piping NPS 2-1/2" and larger.
  3. PP-R pipe, fittings for PP-R pipe; and electro-fusion joint.
- F. Aboveground domestic water piping NPS 2 and smaller shall be one of the following:
1. PEX tube, fittings for PEX tube; and cold expansion joints.
  2. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper, solder-joint fittings, press fittings and soldered joints.

END OF SECTION



## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Automatic thermostatic balancing valves.
4. Temperature-actuated, water mixing valves.
5. Wall hydrants.
6. Hose Bibbs.
7. Drain valves.
8. Water-hammer arresters.
9. Trap-seal primer valves.
10. Outlet boxes.

#### 1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- ##### A. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- ##### A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

- ##### A. NSF Compliance: The lead contents of pipes, fittings, valves and fixtures used to supply potable water throughout the domestic water system shall meet the requirements of NSF 61-G and ANSI 372 shall not contain more than a weighted average of 0.25% lead when used with respect to the wetted surfaces of pipes, pipe fittings, valves, plumbing fittings and fixtures.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61. Mark "NSF-pw" on plastic piping components.

### 2.2 PERFORMANCE REQUIREMENTS

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

### 2.3 VACUUM BREAKERS

- A. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011.
  - 2. Body: Bronze, non-removable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: Chrome or nickel plated.

### 2.4 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  - 1. Standard: ASSE 1013.
  - 2. Operation: Continuous-pressure applications.
  - 3. Pressure Loss: 12 psig maximum, through middle third of flow range.
  - 4. Size: NPS 4.
  - 5. Design Flow Rate: 200 gpm.
  - 6. Body: Stainless steel.
  - 7. End Connections: Flanged.
  - 8. Configuration: Designed for horizontal, straight-through flow.
  - 9. Accessories:
    - a. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- B. Double-Check, Backflow-Prevention Assemblies:
  - 1. Standard: ASSE 1015.
  - 2. Operation: Continuous-pressure applications unless otherwise indicated.
  - 3. Pressure Loss: 5 psig maximum, through middle third of flow range.
  - 4. Size: NPS 6
  - 5. Body: Ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NSP 2-1/2 and larger.
  - 6. End Connections: Coordinate type with Civil.
  - 7. Configuration: Designed for vertical flow.



8. Accessories:

- a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
- b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

C.

2.5 AUTOMATIC THERMOSTATIC BALANCING VALVES

- A. Furnish and install self-actuating thermostatic balancing valve assemblies, equal to "Circuit Solver, as manufactured by "Therm-Omega-Tech, Inc.", or equal. The assembly shall be self-contained and fully automatic without additional piping or control mechanisms.
- B. The valve assembly shall be suitable for use in domestic hot water recirculating systems and shall be NSF/ANSI 61 certified. The unit shall regulate the flow of recirculated hot water based on water temperature entering the valve regardless of system operating pressure. When fully closed, the valve shall by-pass a small amount of hot water to maintain dynamic control of the recirculating loop.
- C. The assembly shall be factory assembled and consist of 3/4" FNTP threaded ball valves on each end, a stainless steel Circuit Solver thermostatic balancing valve and union. The assembly shall be lead free.
- D. The assembly shall be rated to 200 psig working pressure and 300 degree F maximum working temperature. The thermal actuator shall be spring loaded and self-cleaning, delivering closing thrust sufficient to keep the orifice opening free of scale deposits.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves (MV1):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Lawler Manufacturing Company, Inc.
  - b. Leonard Valve Company.
  - c. Powers; a division of Watts Water Technologies, Inc.
  - d. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 degrees F.
9. Selected Valve Flow Rate at 15-psig Pressure Drop: 75 gpm.
10. Pressure Drop at Design Flow Rate: 15 psig.

11. Valve Finish: Rough bronze.

## 2.7 WALL HYDRANTS

### A. Non-freeze Wall Box Hydrant (Narrow Wall Installation)

1. Standard: ASME A112.21.3 for wall mounting within a narrow wall situation allowing for a 4" maximum depth of installation.
2. Pressure Rating: 125 psig.
3. Operation: Loose Key.
4. Inlet: NPS 3/4.
5. Outlet: Concealed.
6. Box and Cover: Chrome plated, cast bronze enclosure box, threaded or solder joint inlet connection that allows 360 degree swivel to any position.
7. Connection: Unit shall be concealed in a chrome plated, cast bronze box with a full 180 degree cover opening.
  - a. Non-removable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.

### B. Non-freeze, Concealed Cold-Water Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rods: Of length required to match wall thickness. Include wall clamps.
5. Inlet: NPS 3/4.
6. Outlet: Concealed.
7. Box: Deep, flush mounted with cover.
8. Box and Cover Finish: Chrome plated.
9. Vacuum Breaker:
  - a. Non-removable, manual-drain-type, hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
  - b. Garden-hose thread complying with ASME B1.20.7 on outlet.
10. Operating Keys(s): One with each wall hydrant.

## 2.8 HOSE BIBBS:

### A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Service Areas: Rough bronze.

9. Operation for Service Areas: Wheel handle.
10. Include operating key with each operating-key hose bibb.

## 2.9 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.10 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Precision Plumbing Products, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products.
  - g. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.11 TRAP-SEAL PRIMER DEVICE

### A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. MIFAB, Inc.
  - b. Precision Plumbing Products, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

- d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
  2. Standard: ASSE 1018.
  3. Pressure Rating: 125 psig minimum.
  4. Body: Bronze.
  5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
  6. Air Gap Fitting: Required.
  7. Distribution unit: Required for back to back or side by side toilet rooms where one trap primer is to feed multiple floor drains.
  8. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
  9. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
- B. Electronic Trap-Seal Primer Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Precision Plumbing Products, Inc.
  2. Standard: ASSE 1044.
  3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
  4. Cabinet: Surface-mounted steel box with stainless-steel cover.
  5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
    - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  6. Vacuum Breaker: ASSE 1001.
  7. Number Outlets: As required by application.
  8. Size Outlets: NPS 1/2.

## 2.12 OUTLET BOXES

- A. Clothes Washer Outlet Boxes:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Acorn Engineering Company.
    - b. Guy Gray Manufacturing Co., Inc.
    - c. IPS Corporation.
    - d. Oatey.
  2. Mounting: Recessed.
  3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Acorn Engineering Company.
  - b. IPS Corporation.
  - c. Oatey.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 ball valve and NPS 1/2 copper, water tubing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-exterior. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install cabinet-type units surface mounted on wall as specified.
- C. Install water-hammer arresters in water piping according to PDI-WH 201.
- D. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

### 3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Test each reduced-pressure-principle backflow preventer (and Division 21 furnished/Division 22 installed sprinkler system double-check, backflow-prevention assembly) according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.4 ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

B. Related Requirements:

1. Section 220500 "Plumbing Basic Materials and methods".
2. Section 220719 "Plumbing Piping Insulation" PVC piping located within a plenum space shall be insulated with insulation rated for flame spread index of 25 or less and smoke development index if 50 or less.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-Sewer" for plastic sewer piping.
- C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) or be listed by NSF International.
- D. All standard duty couplings for Hub-less cast iron soil pipe and fittings shall conform to CISPI 310 and be certified by NSF International.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

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

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ANACO-Husky.
    - b. Fernco Inc.
    - c. MIFAB, Inc.
    - d. Mission Rubber Company; a division of MCP Industries, Inc.
    - e. Tyler Pipe.
  - 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Joint Restraint:
  - 1. CISPI Designation 310-11, CISPI Designation 301-09 , large diameter no-hub cast iron fittings, over 4 inch in size, shall be provided with supplemental support to minimize the risk of joints separation under high thrust conditions. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation. Field devised methods and materials shall not be used to accomplish this application solution.

### 2.4 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.



- C. Solder: ASTM B 32, lead-free with ASTM B 813, water-flushable flux.

## 2.5 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
  - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 3. Unshielded, Non-pressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Fernco Inc.
      - 2) Mission Rubber Company; a division of MCP Industries, Inc.
    - b. Standard: ASTM C 1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.

- 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

## PART 3 - EXECUTION

### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. 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.
- J. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  1. Sanitary Drain: 1/4 inch per foot downward in direction of flow for piping NPS 2-1/2 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 3 and larger.
  2. Vent Piping: Slope down toward vertical fixture vent or toward vent stack.

- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- M. Install aboveground PVC piping according to ASTM D 2665.
- N. Install underground PVC piping according to ASTM D 2321.
- O. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section "Plumbing Basic Materials and Methods".

### 3.2 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- D. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Unshielded, non-pressure transition couplings.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for above ground horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Install individual, straight, horizontal piping runs:
    - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Install hangers for cast-iron soil piping in accordance with MSS SP-69 recommendations and manufacturer's written instructions.
- E. Install supports for vertical cast-iron soil piping at every floor level.
- F. Install hangers for copper tubing in accordance with MSS SP-69 recommendations and manufacturer's written instructions.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 HANGER AND SUPPORT INSTALLATION (UNDERGROUND PIPING)

- A. Provide stainless steel hanger rods to support all soil and waste drainage piping installed below building slabs. Rods shall be minimum 1/4" diameter, type 316 stainless steel spaced at 5'-0" maximum spacing for cast iron piping and 4'-0" for PVC piping with hanger occurring at all pipe joints or in accordance with N.O. S&WB, whichever is less. Provide saddle at PVC pipe. Refer to drawings for requirements. The rod shall be bent into the center of the slab and span a minimum two steel reinforcing bars. Additional, provide support at each joint or fitting and at each "P-trap" and closet bend.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220500 "Plumbing Basic materials and Methods."

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing

additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping shall be the following:
  1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Vent piping contained within enclosed walls shall be the following:
  1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Vent piping within the ceiling plenum shall be the following:
  1. Hub-less, cast-iron soil pipe and fittings; CISPI hub-less-piping couplings; and coupled joints.
  2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints. PVC piping within plenum shall be insulated.
- E. Underground, soil, waste, and vent piping shall be any of the following:
  1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor and shower drains.
3. Miscellaneous sanitary drainage piping specialties.
4. Flashing materials.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

#### 1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts (CO):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Drainage Products.
  - f. Zurn Plumbing Products Group.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts (FCO):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra Heavy Duty.
13. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts (WCO):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access Panel: Square, wall-installation frame and cover. Refer to Section 220500 "Plumbing Basic Materials and Methods" for Access Door requirements.

2.2 FLOOR AND SHOWER DRAINS

A. Cast-Iron Floor and Shower Drains (General Purpose):



1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.3.
3. Pattern: Floor and shower drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
10. Sediment Bucket: Required for Mechanical room floor drains.
11. Top or Strainer Material: Bronze.
12. Top of Body and Strainer Finish: Nickel bronze.
13. Top Shape: Round.
14. Inlet Fitting: Required for trap-seal primer valve connection.

B. Cast-Iron Floor and Shower Drains (Anti-ligature Purpose):

1. Standard: ASME A112.6.3.
2. Pattern: Floor and shower drain.
3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Flashing Collar: Reversible.
6. Clamping Device: Required.
7. Outlet: Bottom.
8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
9. Strainer: Ligature resistant Type 304, stainless steel with vandal proof screws.
10. Strainer Head: Nickel Bronze, adjustable height.
11. Strainer Slots: Six, ligature resistant.
12. Top Shape: Round with ligature resistant baffle.
13. Inlet Fitting: Required for trap-seal primer valve connection.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains (HD):

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

## 2.4 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
  - 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
  - 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 75 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access doors, of types indicated, with frame and cover flush with finished wall.
- D. Install floor and shower drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position drains for easy access and maintenance.
  - 2. Set drains below elevation of surrounding finished floor to allow floor/shower drainage.
  - 3. Install drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
  - 5. Install anti-ligature drains in all Safety Risk Assessment Areas classified Level II –V.

- E. Assemble open drain fittings and install with top of hub 1 inch above floor.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Exception: Trap primers are not required on shower drains or hub drains.
  - 3. Size: Same as floor drain inlet.
- G. Hub drains located above finished ceilings that receive condensate waste from HVAC equipment shall have the condensate drain line caulked tight into the drain opening.
- H. Install flashing/counter flashing, or other suitable flashing system, on each vent pipe passing through roof.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
- C. Set flashing on roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

### 3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220500 "Plumbing Basic Materials and Methods."

### 3.5 PROTECTION

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

END OF SECTION

## SECTION 221413 - STORM DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.
- B. Product Data: For each type of product indicated.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ANACO-Husky.
    - b. Clamp-All Corp.

- c. MIFAB, Inc.
  - d. Mission Rubber Company; a division of MCP Industries, Inc.
  - e. Tyler Pipe.
2. Standards: ASTM C 1277 and ASTM C 1540.
  3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Joint Restraint:
1. CISPI Designation 310-11, CISPI Designation 301-09 , large diameter no-hub cast iron fittings, over 4 inch in size, shall be provided with supplemental support to minimize the risk of joints separation under high thrust conditions. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation. Field devised methods and materials shall not be used to accomplish this application solution.

## 2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.4 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
  3. Unshielded, Non-pressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1) Fernco Inc.
  - 2) Mission Rubber Company; a division of MCP Industries, Inc.
- b. Standard: ASTM C 1173.
- c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- d. Sleeve Materials:
  - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of

lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

- J. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Storm Drain: 1/8 inch per foot downward in direction of flow.
  - 2. Horizontal Storm-Drainage Piping: 1/8 inch per foot downward in direction of flow.
- K. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Install underground PVC piping according to ASTM D 2321.
- M. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of gyp-board walls. Comply with requirements for sleeves specified in Section 220500 "Plumbing Basic Materials and Methods."

### 3.2 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Non-pressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Unshielded, non-pressure transition couplings.



### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Individual, Straight, Horizontal Piping Runs:
    - a. MSS Type 1, adjustable, steel clevis hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping at base and at each floor.
- D. Install hangers for cast-iron soil piping in accordance with MSS SP-69 recommendations and manufacturer's written instructions.
- E. Install supports for vertical cast-iron soil piping at every floor level.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 HANGER AND SUPPORT INSTALLATION (UNDERGROUND PIPING)

- A. Provide stainless steel hanger rods to support all soil and waste drainage piping installed below all structurally supported slabs that are not building slabs (service yards, driveways, etc.). Rods shall be minimum 1/4" diameter, type 316 stainless steel spaced at 4'-0" maximum spacing with hanger occurring at all pipe joints or in accordance with New Orleans Sewerage & Water Board, whichever is less. Provide saddle at PVC pipe. Refer to drawings for requirements. The rod shall be bent into the center of the slab and span a minimum two steel reinforcing bars. Additional, provide support at each joint or fitting.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
  - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220500 "Plumbing Basic Materials and Methods."

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

### 3.9 CLEANING

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

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

- B. Storm drainage piping shall be the following:
1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  2. PVC piping located within a plenum space shall be insulated.
  3. All horizontal runs within building shall be insulated.

END OF SECTION



## SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Roof drains.
  2. Miscellaneous storm drainage piping specialties.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

### PART 2 - PRODUCTS

#### 2.1 METAL ROOF DRAINS

- A. Cast-Iron, Large-Sump, General-Purpose Roof Drains (RD):
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Josam Company.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.
    - d. Tyler Pipe.
    - e. Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation
  2. Standard: ASME A112.6.4, for general-purpose roof drains.
  3. Body Material: Cast iron.
  4. Dimension of Body: Nominal 14-inch diameter.
  5. Combination Flashing Ring and Gravel Stop: Required.
  6. Outlet: Bottom.
  7. Underdeck Clamp: Required.
  8. Dome Material: Aluminum.
- B. Cast-Iron, Large-Sump, Overflow Roof Drains (OFD):

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.
  - d. Tyler Pipe.
  - e. Watts Water Technologies, Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 14-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Underdeck Clamp: Required.
8. Dome Material: Aluminum.
9. Water Dam: Integral exterior water dam.
10. Dam Height: 3 inches.

## 2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

### A. Conductor Nozzles:

1. Description: Bronze body with slip joint inlet with set screws and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

## 2.3 CLEANOUTS

### A. Floor Cleanouts (FCO):

1. Same as for sanitary drainage system.
2. Refer to Section 220500 for types and requirements.

### B. Test Tees (CO):

1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Raised head, brass.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### C. Wall Cleanouts (WCO):

1. Same as for sanitary drainage system.
2. Refer to Section 220500 for types and requirements.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
  - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Position roof drains for easy access and maintenance.
  - 3. All roof drain components shall be insulated in same fashion as storm drainage pipe.
- B. Install conductor nozzles at exposed bottom of overflow drain conductors where they spill onto grade.
- C. Install cleanouts in aboveground piping and building drain piping.
- D. For cleanouts located in concealed piping, install cleanout wall access doors with frame and cover flush with finished wall.
- E. Install test tees in exposed vertical conductors and near floor.
- F. Install wall cleanouts in concealed vertical conductors. Install access doors.

#### 3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

#### 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.
- C. Any exposed PVC components in ceiling plenum shall be insulated in same fashion as storm drainage piping.

END OF SECTION





## SECTION 221449 – NATURAL GAS PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping and tubing joining materials.
  - 3. Valves.
  - 4. Pressure regulators.
  - 5. Pressure gages.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.

#### 1.3 SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Refer to Division 1 "Operation and Maintenance Data".

#### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- D. Installer shall be qualified, licensed and familiar with the installation of “cold-press” mechanical systems.

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded or cold press ends.
  3. Cold press mechanical joint fittings shall conform to material requirements of ASTM A420 or ASME B16.3 and performance criteria of ANSI/CSA LC4. Sealing elements for press fittings shall be HNBR. Sealing elements shall be factory installed. Fittings shall utilize a sealing system that will allow leakage from inside the piping to pass past the sealing element of an un-pressed connection to identify un-pressed fitting prior to putting the system into operation.
- B. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

### 2.2 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.
- D. Cold Pressed Joints: Mechanical cold pressed fittings shall be installed using the proper tools, actuators, jaws and rings as instructed by the press fitting manufacturer.

### 2.3 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads or Flare Ends: Comply with ASME B1.20.3.
  - 4. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 5. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated brass.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Separate packnut with adjustable-stem packing threaded ends.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig.
  - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
  - 1. Body: Bronze, complying with ASTM B 584.
  - 2. Ball: Chrome-plated bronze.
  - 3. Stem: Bronze; blowout proof.
  - 4. Seats: Reinforced TFE; blowout proof.
  - 5. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 7. CWP Rating: 600 psig.
  - 8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B 584.
2. Plug: Bronze.
3. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. PE Ball Valves: Comply with ASME B16.40.

1. Body: PE.
2. Ball: PE.
3. Stem: Acetal.
4. Seats and Seals: Nitrile.
5. Ends: Plain or fusible to match piping.
6. CWP Rating: 80 psig.
7. Operating Temperature: Minus 20 to plus 140 degrees.
8. Operator: Nut or flat head for key operation

## 2.4 PRESSURE REGULATORS

A. General Requirements:

1. Single or multiple stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Overpressure Protection Device: Factory mounted on pressure regulator.
10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
11. Maximum Inlet Pressure: 10 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.

4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 5 psig.

## 2.5 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. Trerice, H. O. Co.
  - e. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - f. Weiss Instruments, Inc.
  - g. WIKA Instrument Corporation - USA.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Stainless steel.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.6 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread

## 2.7 DIELECTRIC UNIONS

- A. Dielectric Unions:
  1. Description:
    - a. Standard: ASSE 1079.

- b. Pressure Rating: 125 psig minimum at 180 deg F.
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

## 2.8 LABELING AND IDENTIFYING

- A. Detectable Warning Tape (For Underground Piping): Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.
- B. Refer to Section 220500 "Plumbing Basic Materials and Methods" for above ground piping requirements.

## PART 3 - EXECUTION

### 3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 3 "Earth Moving" for excavating, trenching, and backfilling.
  - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774
- D. Install fittings for changes in direction and branch connections.
- E. Install pressure gages upstream and downstream from each service regulator.
- F. All exterior ferrous gas piping shall be painted in accordance with Division 9 requirements.

### 3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Do not install gas valves or unions in return air plenums.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- H. Locate valves for easy access.
- I. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- Q. Connect branch piping from top or side of horizontal piping.
- R. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- S. Do not use natural-gas piping as grounding electrode.
- T. Install strainer on inlet of each line-pressure regulator.
- U. Install pressure gage upstream and downstream from each line regulator.

- V. Install sleeves for piping penetrations of walls. Refer to Section 220500 "Plumbing Basic Materials and Methods".

### 3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance.
- B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

### 3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Cold Pressed Joints:
  - 1. Mechanical cold pressed fittings shall be installed using the proper tools, actuators, jaws and rings as instructed by the press fitting manufacturer.
  - 2. System shall be installed in accordance with the "listing" requirements outlined in document "PMG Listing 1036" by ICC-ES.
- E. 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

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for horizontal steel piping in accordance with MSS SP-69 recommendations.



### 3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 220500 "Plumbing Basic Materials and Methods".
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- D. Refer to Division 1 "General Commissioning Requirements" for further requirements.

### 3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
- B. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
- C. Aboveground natural-gas piping shall be one of the following based on the piping schedule below:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with carbon steel mechanical cold pressed joints.

3.10 INDOOR PIPING SCHEDULE

A. Aboveground piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with carbon steel mechanical cold pressed joints.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION

## SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Gas-fired, tankless, domestic-water heaters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Gas-Fired, Tankless, Domestic-Water Heaters:
      - 1) Heat Exchanger: Five years.
      - 2) Controls and Other Components: Three years.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. ASHRAE/IES Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IES 90.1.
- C. ASME Compliance:
  - 1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### 2.2 GAS-FIRED, TANKLESS, DOMESTIC-WATER HEATERS

- A. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
- B. Standard: ANSI Z21.10.3/CSA 4.3 for gas-fired, instantaneous, domestic-water heaters for outdoor application.
- C. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
  - 1. Tapping's: ASME B1.20.1 pipe thread.
  - 2. Pressure Rating: 150 psig.
  - 3. Heat Exchanger: Stainless steel.
  - 4. Insulation: Comply with ASHRAE/IES 90.1.
  - 5. Jacket: Metal, with enameled finish, or plastic.
  - 6. Burner: For use with tankless, domestic-water heaters and natural-gas fuel.
  - 7. Automatic Ignition: Manufacturer's proprietary system for automatic, gas ignition.
  - 8. Temperature Control: Adjustable thermostat.
- D. Support: Bracket for wall mounting.

### 2.3 SOURCE QUALITY CONTROL

- A. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

### PART 3 - EXECUTION

#### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Tankless, Domestic-Water Heater Mounting: Install tankless, domestic-water heaters at least 18 inches above floor on wall bracket.
  - 1. Maintain manufacturer's recommended clearances.
  - 2. Arrange units so controls and devices that require servicing are accessible.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 5. Anchor domestic-water heaters to substrate.
- B. Install domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
  - 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
- C. Install gas-fired, domestic-water heaters in accordance with NFPA 54.
  - 1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
  - 2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
  - 3. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Section 221123 "Facility Natural-Gas Piping."
- D. Install combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend domestic-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- F. Charge domestic-water expansion tanks with air to required system pressure.

### 3.2 PIPING CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
- B. Comply with requirements for gas piping specified in Section 221123 "Facility Natural-Gas Piping."
- C. Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### 3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Domestic-water heaters will be considered defective if they do not pass tests and inspections.

### 3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, tankless domestic-water heaters. Training shall be a minimum of one hour(s).

END OF SECTION

## SECTION 224000 - PLUMBING FIXTURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes plumbing fixtures and related components.
- B. See Division 22 Section "Plumbing Specialties" for specialty fixtures not in this Section.

#### 1.2 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. All plumbing fixtures designated for use in Safety Risk Assessment Levels II-V shall be designed as "ligature-resistant" plumbing fixtures.

#### 1.3 SUBMITTALS

- A. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Operation and maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61-G, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

- G. All plumbing fixtures designated for use in Safety Risk Assessment Levels II-V shall be designed as "ligature-resistant" plumbing fixtures.

#### 1.5 POTABLE WATER NO-LEAD REQUIREMENTS

- A. NSF Compliance: The lead contents of pipes, fittings, valves and fixtures used to supply potable water throughout the domestic water system shall meet the requirements of NSF 61-G and ANSI 372 shall not contain more than a weighted average of 0.25% lead when used with respect to the wetted surfaces of pipes, pipe fittings, valves, plumbing fittings and fixtures.

### PART 2 - PRODUCTS

#### 2.1 PLUMBING FIXTURES (Basis of Design)

- A. Refer to Plumbing Fixture Schedule shown on the Drawings.

### PART 3 - EXECUTION

#### 3.1 FIXTURE INSTALLATION

- A. Fixtures that are specified as ADA Compliant, are to be installed at ADA Compliant heights. Refer to the Architectural plans for mounting heights and details.
- B. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- C. For wall-hanging fixtures, install concealed arm carriers affixed to building substrate.
- D. Install back-outlet, wall-hanging fixtures onto waste fitting seals and attach to supports.
- E. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.
- H. Install water-supply piping with chrome plated, brass, quarter-turn stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Fixtures provided with flush valves.
- I. Install chrome plated, brass trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.



- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on "non-ligature resistant" water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
- N. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for escutcheons.
- O. Set service basins in leveling bed of cement grout. Refer to Division 22 Section "Basic Mechanical Materials and Methods" for grout.
- P. Install water hammer arrestors on all fixtures and equipment supplied with flushometer valves and quick closing valves. Water hammer arrestors shall be installed above accessible ceilings. Refer to Division 22 Sections "Plumbing Specialties" for water hammer arrestors.
- Q. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

### 3.2 CONNECTIONS

- A. Connect water supplies from water distribution piping to fixtures and equipment.
- B. Connect drain piping from fixtures and equipment to sanitary sewer piping.
- C. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.
- D. Supply and Waste Connections to Fixtures and Equipment Specified in Other Sections: Connect fixtures and equipment with water supplies, stops, risers, traps, and waste piping specified. Use size fittings required to match fixtures and equipment. Connect to plumbing piping.

### 3.3 ADJUSTING

- A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.
- B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed plumbing fixtures and fittings.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

## SECTION 230000 - HVAC GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This section, as well as the Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 - General Sections included in Division 23 Specifications are for mechanical and related work. Coordinate with plans and other specifications sections.

#### 1.2 RELATED DOCUMENTS

SECTION 230000 - HVAC GENERAL REQUIREMENTS  
SECTION 230500 - BASIC MATERIALS AND METHODS  
SECTION 230514 - ENCLOSED CONTROLLERS (MOTOR STARTERS)  
SECTION 230515 - VARIABLE FREQUENCY CONTROLLERS  
SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING  
SECTION 230519 - METERS AND GAGES FOR HVAC PIPING  
SECTION 230523 - VALVES  
SECTION 230529 - HANGERS AND SUPPORTS  
SECTION 230548 – MECHANICAL VIBRATION CONTROLS  
SECTION 230553 – MECHANICAL IDENTIFICATION  
SECTION 230593 - TESTING, ADJUSTING, AND BALANCING  
SECTION 230713 - DUCT INSULATION  
SECTION 230719 - PIPE INSULATION  
SECTION 230800 - HVAC FUNCTIONAL CHECK OUT  
SECTION 230923 - DIRECT DIGITAL CONTROL SYSTEM  
SECTION 231123 - FACILITY NATURAL GAS PIPING  
SECTION 232300 – REFRIGERANT PIPING  
SECTION 233113 - METAL DUCTS  
SECTION 233300 - DUCT ACCESSORIES  
SECTION 233423 - POWER VENTILATORS  
SECTION 233600 - AIR TERMINALS  
SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES  
SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS  
SECTION 237414 – VAV ROOFTOP AIR CONDITIONERS  
SECTION 237416 – SINGLE ZONE ROOFTOP AIR CONDITIONERS  
SECTION 238126 – MINI SPLIT SYSTEMS

#### 1.3 WORK INCLUDED

- A. The work covered by this Division of the Specifications consists of furnishing all plant, labor, equipment, supervision, appliances, and materials, and in performing all operations in connection with the plumbing, fire protection, air conditioning, heating and ventilating systems

complete and in strict accordance with this Division of the Specifications and the applicable drawings.

#### 1.4 COORDINATION OF WORK

- A. General: Refer to the Division 1 sections for general coordination requirements applicable to the entire work. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the mechanical work, and in its interface with other work, including electrical work, and that such establishment is the exclusive responsibility of the Contractor. The contractor shall modify routing and location as required to coordinate with other trades at no additional cost to the owner.
- B. Advise other trades of openings required in their work for the subsequent move-in of large equipment.
- C. Submit coordination drawings prior to purchase-fabrication-installation of any of the elements involved in the coordination.
- D. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- E. Verify all dimensions by field measurements.
- F. Arrange for chases, slots, and openings in other building components to allow for installation. Contractor shall provide field mark ups for structural penetrations.
- G. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- H. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the installation areas.
- I. Coordinate the cutting and patching of building components to accommodate the installation of equipment and materials. Comply with Division I.
- J. Install equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- K. Coordinate the installation of materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- L. Contractor shall visit the site before bidding to familiarize himself with conditions under which he will have to perform his Contract.

#### 1.5 EXISTING CONDITIONS

- A. The utilities and information shown on the drawings are based on information provided to the designers by the architect or utility company. Contractor shall field verify existing conditions and notify architect in writing of any discrepancies prior to commencing with new work.

#### 1.6 INTERRUPTION OF SERVICES

- A. All work shall be accomplished at a time most convenient to the owner and so that the interruption of service (water, gas, heating, and air conditioning) shall be minimum and only for changeover.
- B. No service shall be interrupted or changeover begun until the time and duration of service interruption have been agreed to, in writing, signed by the Owner's Representative, the Architect, and the Contractor.
- C. Temporary connections, or temporary rerouting to serve existing facilities will be required as the work progresses. Make due allowances in bid.

#### 1.7 CODES AND STANDARDS

- A. Workmanship, material and equipment shall be in accordance with Specifications and Drawings, and in some instances the requirements exceed those required by codes and standards. Where not exceeded, the codes and standards shall be considered as absolute minimum requirements.

#### 1.8 ELECTRICAL WORK

- A. Refer to Division 26 for all electrical work as it pertains to work specified in this section.

#### 1.9 WORKMANSHIP

- A. Install all materials and components of the work in accordance with instructions of manufacturer following the best modern construction practices and conforming with the Contract Documents. Workmanship shall be first class, in both function and appearance, whether finally concealed or exposed and shall be performed by experienced workmen skilled in the type of work. As practicable, the lines of all exposed components of the system shall be perpendicular or parallel to the lines of the building.

#### 1.10 DRAWINGS

- A. Contract Drawings and details are shown to limit and explain structural conditions, requirements, and manner of erecting work. Drawings are intended to convey the scope of work and indicate general arrangements of equipment, ducts and piping and approximate sizes and locations of equipment and outlets. Trades shall follow these drawings in laying out their work, check general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.
- B. It may be necessary to shift pipes and/or ducts and this is permissible, and may be required under the general contract, but all such changes must be referred to the Architect for approval.

Where rearrangement of piping or equipment is required, contractor shall prepare and submit approval drawings of the proposed arrangement.

- C. Where the Contractor is not certain about the method of installation, he shall ask for details. Lack of details, not requested, will not be an excuse for improper installation, and any such work must be corrected.

#### 1.11 SHOP DRAWINGS AND DATA TO BE SUBMITTED

- A. Submit adequate engineering data on each piece of equipment to allow a careful check of compliance with the technical requirements of the Contract documents. Clearly indicate on submitted data the manufacturer's name, piece number, equipment capacity, and other applicable technical data. Refer to individual sections for specific requirements.
- B. Corrections or comments made on shop drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents, Plans and Specifications. Shop Drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the contract documents. Review of Shop Drawings shall not relieve the Contractor from responsibility for confirming and correlating all quantities and dimensions, coordinating work with that of all other trades, and performing work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviation from Plans and Specifications. Shop Drawings must be accompanied by signed statement from contractor, stating that he has reviewed the submittal and checked it for compliance.
- C. Shop Drawings: Submit 1/4-inch minimum scale coordinated shop drawings relating to the duct systems, showing clearances and relationship to structural members, piping, lights and ceilings. Shop drawings for all ductwork must be submitted and reviewed before any ductwork is constructed or installed.
- D. Submit a 1/4" scale layout of each mechanical room or roof showing the location, arrangement, etc. of all such equipment to be installed in this room.
- E. Contractor shall provide products as specified if submittals for review of materials are not received within thirty (30) days after award of the Contract.
- F. Any item not specified herein but submitted as a substitute for the specified item shall be accompanied by manufacturers's documentation starting/illustrating the following applicable information in addition to the specific information requested in other sections.
  - 1. Dimensions/weight.
  - 2. Electrical ratings-voltage, amperage, short circuit capability, etc.
  - 3. Construction - gauge of steel/aluminum, paint finish/application method, color, NEMA type, etc.
  - 4. Warranty.

#### 1.12 INSTRUCTIONS

- A. Contractor shall provide formal training sessions for all mechanical systems provided under this contract. Training shall be provided by competent instructors who will give full instruction to designated personnel in the adjustment, operation, and maintenance, including pertinent safety

requirements of the equipment or system specified. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Owner for regular operation. The length of training session(s) shall be as long as required to review the mechanical systems to the owner's satisfaction with the exception of systems with specified training requirements. There is no limit to the number of attendees on behalf of the owner.

- B. Training sessions shall be coordinated to provide the owner with sequential training of all mechanical systems and equipment. Impromptu training without proper documentation is not acceptable as formal training.
- C. The contractor is solely responsible for initiating, coordinating, and documenting owner training sessions. The contractor shall:
  - 1. Schedule the training session with the owner's representative in writing, allowing sufficient time for the owner to notify the necessary attendees.
  - 2. Provide a written agenda outlining the systems to be addressed in a given session.
  - 3. Provide a sign in sheet and minutes of the training session.
  - 4. Distribute the above documentation to the owner and architect as proof of completing formal training.

#### 1.13 OPERATING AND MAINTENANCE MANUALS

- A. Bind in looseleaf binders with the words, "Operating and Maintenance Manual" and the project identification imprinted on the cover. Prepare three complete sets of records for the Owner, with table of contents, index, and tabbed section dividers. Bidder shall also provide an electronic copy of the O&M's on disk in pdf format.
- B. During the construction period, accumulate the following for inclusion in the Operating and Maintenance Manuals:
- C. Copies of warranties and guarantees on each piece of equipment installed.
  - 1. Wiring and control diagrams.
  - 2. Shop Drawings.
  - 3. Operating instructions for:
  - 4. HVAC Systems
  - 5. Recommended maintenance procedures.
- D. Submit the manuals for approval at approximately 75 percent job completion. Each manual shall consist of:
  - 1. Complete description of each item of equipment and apparatus furnished and installed - including ratings, capacities, and characteristics.
  - 2. Fully detailed parts list, including all numbered parts of each item of equipment and apparatus furnished and installed.
  - 3. Manufacturer's printed instructions describing operation, servicing, maintenance and repair of each item of equipment and apparatus.
  - 4. Provide serial and model numbers for all equipment.

#### 1.14 ON SITE OPERATION MANUALS

1. Provide and install waterproof box permanently mounted in same room as installed equipment to house operation and maintenance manual for equipment. This is in addition to the operation and maintenance manuals provided in section 1.13.

#### 1.15 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications, adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of materials and equipment to minimize construction site congestion.

### PART 2 - PRODUCTS

#### 2.1 AVAILABLE MANUFACTURERS

- A. Manufacturer's names and catalog numbers are scheduled or specified for the purpose of establishing standard of design, quality, appearance, performance and serviceability, and not to limit competition. Scheduled products (as may be modified by detailed Specifications) are those selected as the basis for system design with respect to physical size and space arrangements, required capacity and performance characteristics, and the product quality intended.
- B. The Drawings indicate specified products physically arranged in the spaces, as catalogued by Specific manufacturers, generally as listed in the equipment schedules.
- C. Listed "Acceptable Manufacturers" are those considered capable of manufacturing products conforming to detailed Specifications, and as such, are invited to compete on an equal basis provided the offering is comparable in every respect to scheduled or specified products and actually conforms to the detailed Specifications and schedule requirements. Listing herein as "acceptable manufacturers" does not imply "accepted," "approved," "prior approval," or any other such connotation.

#### 2.2 DUCT MOUNTED SMOKE DETECTORS

- A. Duct detectors shall be provided and installed as required by NFPA 90A and Standard Mechanical Code and in other locations indicated on the plans. Contractor shall provide duct configuration suitable for detector installation.
- B. Smoke detectors shall be the ionization type provided, installed and commissioned by Division 23 unless specified under Division 16 "Fire Alarm", in which case the duct detector shall be provided by Division 26 and mounted by Division 23.
- C. General: Include the following features:



1. Operating Voltage: 24-V dc, nominal. Provide transformer if required.
2. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
4. Integral Visual-Indicating Light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

### 2.3 FLAME-SPREAD AND SMOKE DEVELOPED PROPERTIES OF MATERIALS

- A. Materials and adhesives used throughout the mechanical and electrical systems for insulation, acoustical lining, filters, ducts, flexible connections, and jackets or coverings regardless of kind, or for piping or conduit system components, shall have a flame-spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. If such materials are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame-spread rating not over 25 and a smoke developed rating not higher than 50.
- B. "Flame-Spread Rating" and "Smoke Developed Rating" shall be as determined by the "Method of Test of Surface Burning Characteristics of Building Materials, NFPA No. 225, ASTM E84, Underwriter's Laboratories, Inc., Standard." Such materials are listed in the Underwriter's Laboratories, Inc. "Building Materials List" under the heading "Hazard Classification (Fire)."

### 2.4 AUXILIARY STRUCTURAL SUPPORTS

- A. Provide auxiliary structural support as necessary to support mechanical systems from the building structure. Supporting members shall be metal strut framing or standard structural shapes, designed to support imposed loads with a working stress no greater than 25 percent of ultimate stress values of the members, and articulation with the building structure without exceeding structural limitations at the point of attachment to the building structure.

### 2.5 SPECIAL TOOLS

- A. Furnish a set of special tools and devices required for the proper maintenance of the major pieces of equipment and install on adequate tool board. This shall include only tools which cannot normally be purchased "over-the-counter" at hardware stores.

### 2.6 EQUIPMENT GUARDS

- A. Provide equipment with exposed moving parts with belt guards, coupling guards, fan guards or other enclosures as necessary for personnel safety.

## 2.7 ACCESS DOORS

- A. Furnish, for installation under appropriate section of the work, access doors at each point required to provide access to concealed valves, dampers, damper operators, and other devices requiring operation, adjustment, or maintenance. Access doors shall be located in inconspicuous locations and in unoccupied areas wherever possible. Access door locations shall be shown on shop drawings for architect approval.
- B. Shall be 16-gauge steel, with mounting straps, concealed hangers, and screwdriver locks, designed for the doors to open 180 degrees, minimum.
- C. Access doors installed in fire walls or partitions shall be U.L. labeled to maintain the fire rating of the wall or partition.
- D. Provide prime coat finish for installation in ceilings or painted or unfinished surfaces.
- E. Provide bronze finish for installation in unpainted finished walls.
- F. Milcor Style M for masonry and surfaces not specified otherwise.
- G. Milcor Style K for plastered surfaces.
- H. Milcor Style DW for drywall surfaces.
- I. Milcor Style AT-FRSC "Special" for drywall ceilings. (Designated "fire resistive suspended ceiling door" by manufacturer).
- J. Milcor Style AT for acoustical tile ceilings.
- K. Milcor Style AP for acoustical plaster ceilings.
- L. Acceptable Manufacturers: Baldwin, Hannon, Josam, Miami, Carey, Milcor, Titus, Wade, Walsh, Zurn.

## PART 3 - EXECUTION

### 3.1 HAZARDOUS LOCATIONS

- A. Air-Moving equipment installed within, or handling air from hazardous locations shall be provided with non-ferrous fan wheels, non-sparking inlet rings, and with explosion proof motors and electrical devices.
- B. "Hazardous Locations" shall be as defined in the National Electrical Code.

### 3.2 PROTECTION OF EQUIPMENT AND MATERIALS

- A. Protect equipment and materials from physical damage, water damage and deterioration after it is delivered to the project, and during the installation.
- B. The equipment shall be kept clean. Motors and electrical devices shall be covered with suitable materials to prevent dirt or dust accumulation within equipment. Machinery and devices shall be properly oiled and maintained to prevent rusting and deterioration.
- C. Repair scratches, mars, or paint deterioration.
- D. Any HVAC system that requires operation during construction shall be protected by MERV 8 filters at all points of air entering the HVAC system. The HVAC system is inclusive of all supply and return duct, air devices, air terminals, plenums, and equipment. The entire air path must be protected. In addition, all equipment specified or normally requiring filtration during normal operation shall be protected by filters meeting or exceeding the specified efficiency. All filters shall be sealed with pressure tape to prevent air leakage around the filter. Under no circumstance shall permanent HVAC systems be operated during any construction activity that generates excessive dust, including but not limited to demolition and sanding. Temporary systems shall be utilized during these activities if ventilation or conditioning is required. Replacement filters shall be installed in all required systems after all construction activity is completed. Substantial completion does not constitute the completion of all construction activity.

### 3.3 MATERIAL DAMAGE

- A. The contractor shall immediately report in writing to the owner and design professional any incident involving equipment or material damage including rain water damage, pipe leaks, physical damage, etc.
- B. At a minimum the report shall include the areas and extent of damage and proposed resolution.
- C. Water damaged materials shall be replaced with new materials without exception.

### 3.4 EQUIPMENT AND PIPE SPACE

- A. The Drawings indicate specified products physically arranged in the spaces, as catalogued by specific manufacturers, generally as listed in the equipment schedules.
- B. Drawings show pipe and ductwork diagrammatically.
- C. Adhere to Drawings as closely as possible in layout of work.
- D. Vary run of piping, run and shape of ductwork and make offsets during progress of work as required to meet structural and other interferences per reviewed shop drawings.
- E. Install piping and ductwork in furred spaces wherever possible. Run exposed piping and ductwork parallel to or at right angles to building walls.

- F. Keep horizontal lines as high as practicable.
- G. Conform to ceiling heights established on the Drawings with adequate clearance for light fixtures.

### 3.5 PAINTING AND FINISHING AND CLEANING

- A. Finish painting (other than factory applied) of mechanical and electrical equipment, and its associated piping, ductwork, and devices is specified in other sections. Provide touch-up painting of pre-finished mechanical products.
- B. Surfaces shall be left clean, debris shall be removed, and equipment shall be furnished in prime coat finish unless otherwise specified.
- C. Piping, ductwork and equipment: Clean exterior of piping, ductwork and equipment, removing rust, plaster and dirt by wire brushing. Remove grease, oil, and similar materials by wiping with clean rags and suitable solvents.
- D. Supports and anchors: Exterior supports and anchors shall be hot dipped galvanized steel with cold galvanized welds.
- E. Motors, pumps and other items with factory finish. Remove grease and oil and leave surfaces clean and polished.
- F. Cleaning operations are supplemented by detailed instructions for specific systems.

END OF SECTION

## SECTION 230500 - BASIC MECHANICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Mechanical demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.

#### 1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- 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.

#### 1.3 SUBMITTALS

A. Product Data: For the following

1. Escutcheons
2. Dielectric fittings
3. Sleeve Seals

B. Welding certificates.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.5 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 such that they are protected from direct sunlight. Support to prevent sagging and bending.

#### 1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, core drilling and openings in building structure during progress of construction, to allow for mechanical installations. Contractor is responsible for providing required penetrations in new and existing structure to accommodate piping.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

### PART 2 - PRODUCTS

#### 2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

#### 2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- D. 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.

### 2.3 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.

### 2.4 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 minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

### 2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EDPM, interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Plastic. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating, of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.6 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

## 2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated.
- C. Not used.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  1. Finish: Polished chrome-plated.

## 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, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical 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. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
  4. Equipment to Be Removed: Disconnect and cap services and remove equipment.



### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors in exposed areas.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs. Cut sleeves to length for mounting flush with both surfaces with the exception of floor sleeves, which shall terminate 4" above the finished floor. Extend sleeves as required to accommodate ring clamps if specified. Seal space outside of sleeve fittings with grout.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Seal all piping penetrations to maintain indicated fire rating of walls, partitions, ceilings, and floors at mechanical penetrations. Refer to architectural fire proofing requirements.
- Q. Verify final equipment locations prior to roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- S. Expansion and Contraction of Piping:
  - 1. Allowance shall be made throughout for expansion and contraction of pipe. Horizontal runs of pipe with expansion loops or joints shall be anchored to the wall or the supporting construction to force expansion toward the expansion joints or loops. Horizontal runs of piping without expansion joints or loops, over 50 feet in length, shall be anchored in the middle of the run to force the expansion evenly toward the ends.
  - 2. All pipe shall be so installed that it may contract or expand freely without damage to any other work or injury to itself. Any swing joints, expansion joints, or bends necessary shall be installed whether shown or not.

### 3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs.
- 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. 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.

### 3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  3. 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 to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install 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.
- D. Install equipment to allow right of way for piping installed at required slope.

- E. Equipment shall be installed at the more stringent elevation required by the local authority having jurisdiction or owner's insurer. The contractor is responsible for verifying the benchmark and setting the proper elevation. Provide supplemental support structure or increase equipment base height to achieve required elevation. Provide permanently mounted access ladder and fenced service area for installations greater than 36" above finished grade.

### 3.6 PAINTING

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

### 3.7 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 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 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 concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."
  - 8. Where existing bases are to remain, extend as required to accommodate new equipment sizes. Dowel into floor and existing base on 18-inch centers.

### 3.8 GROUTING

- A. Mix and install grout for mechanical 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



## SECTION 230514-ENCLOSED CONTROLLERS

### PART - 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. All magnetic starters will be furnished in this Division for installation in Division-26, except starters furnished as part of a motor control center.

#### 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. 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.

- D. 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.
- E. 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 of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.
- 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 70.

#### 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.

#### 1.6 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 features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.
- C. 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.

#### 1.7 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. Spare Fuses: Furnish 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. Eaton Corp.; Cutler-Hammer Products.
    - c. General Electrical Distribution & Control.
    - d. Rockwell Automation Allen-Bradley Co.; Industrial Control Group.
    - e. Siemens/Furnas Controls.
    - f. Square D Co.

### 2.2 MANUAL ENCLOSED CONTROLLERS

- A. Fractional Horsepower Single Phase Manual Starters: Fractional horsepower manual starters shall consist of a manually operated toggle switch equipped with melting alloy type thermal overload relay. Thermal unit shall be of one-piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed. Contacts shall be double break, silver alloy, visible from both sides of starter.
- B. Manual Starters Three Phase: Manual starters shall be constructed and tested in accordance with the latest published NEMA Standards. The manual starters shall consist of a manually operated switch equipped with melting alloy type thermal overload relays. The overload relays shall be trip-free, and the starter shall be inoperative if any thermal units are removed. Thermal units must be of one-piece construction. The starters will be furnished in a NEMA 1 general purpose enclosure unless otherwise indicated on the plans.

### 2.3 MAGNETIC ENCLOSED CONTROLLERS

- A. Description: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated. Across-the-line magnetic starters through NEMA. size seven shall be equipped with

double break silver alloy contacts. All contacts shall be replaceable without removing power wiring or removing starter from panel.

- B. Control Circuit: Control voltage at 120 V shall be 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.

## 2.4 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 3R.
  - 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
  - 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

## 2.5 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Provide HOA Switch and Auxiliary contacts as required by the control sequence and two spare (coordinate with the control sequence specifications): NEMA ICS 2, heavy-duty type.
- C. Control Relays: Auxiliary and adjustable time-delay relays.

## 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 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 26 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.
- C. Install freestanding equipment on concrete bases complying with Division 3 Section "Cast-in-Place Concrete."
- D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

### 3.4 IDENTIFICATION

- A. Identify enclosed controller components and control wiring according to Division 26.

### 3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch (HOA) and other automatic-control devices where applicable.
- D. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

### 3.6 CONNECTIONS

- A. Conduit installation requirements are specified in other Division 26 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 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.8 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.

### 3.9 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 26 Sections.

- D. Complete installation and startup checks according to manufacturer's written instructions.

### 3.10 DEMONSTRATION

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



## SECTION 230515-VARIABLE FREQUENCY CONTROLLERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.
- B. Variable Frequency Drives (VFD), Variable Speed Drives (VSD), Adjustable Frequency Drives (AFD), Adjustable Speed Drives (ASD) and other modulating speed controller references are all synonymous with Variable Frequency Controllers and are work of this section.

#### 1.2 SUBMITTALS

- A. Product Data: Provide dimensions; mounting arrangements; location for conduit entries; and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes for each type of VFC indicated.
- B. Shop Drawings: For each VFC.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Nameplate legends.
    - c. Short-circuit current ratings of integrated unit.
    - d. UL listing for series rating of overcurrent protective devices in combination controllers.
    - e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
  - 2. Wiring Diagrams: Power, signal, and control wiring. Include maximum allowable wiring length between VFC and load.
- C. Field quality-control test reports.
- D. Operation and maintenance data.
- E. 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.
- F. 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.

### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Any VFC system serving a connected load of 100 HP or greater shall meet or exceed IEEE Standard 519-1992, "Harmonic Control for Electrical Systems", when connected to a power system operating within standard industry conditions. The VFC system includes the VFC and any harmonic filters used to reduce harmonic distortion. Filters shall be passive type and shall not become overloaded by upstream harmonic sources, shall not resonate with other power system components, and shall not have compatibility problems with engine generator sets properly sized for the load.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated dimensions and clearances.
- E. Comply with NFPA 70.

### 1.4 COORDINATION

- A. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- B. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load. Provide all necessary programming, components and additional input and output devices and start-up services necessary to support each application.

## 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. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
  - 2. Yaskawa
  - 3. Emerson
  - 4. Danfoss



## 2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of a NEMA MG 1, Design B, 3-phase, **premium**-efficiency induction motor by adjusting output voltage and frequency.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range
- D. Unit Operating Requirements:
1. Input ac voltage tolerance of the equipment voltage plus or minus 10 percent.
  2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
  3. Capable of driving full load without derating with:
    - a. Ambient Temperature: 0 to 40 deg C.
    - b. Humidity: Less than 90 percent (noncondensing).
    - c. Altitude: 3300 feet.
  4. Minimum Efficiency: 96 percent at 60 Hz, full load.
  5. Minimum Displacement Primary-Side Power Factor: 96 percent.
  6. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
  7. Starting Torque: 100 percent of rated torque or as indicated.
  8. Speed Regulation: Plus or minus 1 percent.
  9. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
  10. Unit shall be capable of operating equipment with a minimum 100' wiring between VFC and attached load.
- E. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 50 percent of maximum rpm.
  2. Maximum Speed: 50 to 100 percent of maximum rpm.
  3. Acceleration: 2 to a maximum of 1800 seconds.
  4. Deceleration: 2 to a maximum of 1800 seconds.
  5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- F. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors.
  2. Snubber networks to protect against malfunction due to system voltage transients.
  3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
  4. Motor Overload Relay: Adjustable and capable of NEMA 250, Class **[10] [20] [30]** performance.
  5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
  6. Instantaneous line-to-line and line-to-ground overcurrent trips.
  7. Loss-of-phase protection.

8. Reverse-phase protection.
  9. Short-circuit protection.
  10. Motor overtemperature fault.
  11. Free wheel and full speed start up capability.
- G. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- H. Automatic Reset and Restart: To attempt three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional auto speed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- I. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- J. Torque Boost: Automatically vary starting and continuous torque to at least 1.5 times the minimum torque to insure high-starting torque and increased torque at slow speeds.
- K. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled fan-ventilated motors at slow speeds.
- L. Input Line Conditioning: Provide 3% impedance reactors. DC Line Reactor to reduce harmonics in power line and increase fundamental power factor.
- M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (VDC).
  9. Set-point frequency (Hz).

10. Motor output voltage (V).

P. Control Signal Interface: Provide VFC with the following:

1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
  - a. 0 to 10-V dc.
  - b. 0-20 or 4-20 mA.
  - c. Potentiometer using up/down digital inputs.
  - d. Fixed frequencies using digital inputs.
  - e. RS485.
  - f. Keypad display for local hand operation.
3. Output Signal Interface:
  - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
    - 1) Output frequency (Hz).
    - 2) Output current (load).
    - 3) DC-link voltage (VDC).
    - 4) Motor torque (percent).
    - 5) Motor speed (rpm).
    - 6) Set-point frequency (Hz).
4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
  - a. Motor running.
  - b. Set-point speed reached.
  - c. Fault and warning indication (overtemperature or overcurrent).
  - d. PID high or low speed limits reached.

Q. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.

R. Electronic bypass.

S. Integral Disconnecting Means: KS 1, non-fusible switch with lockable handle.

## 2.3 ENCLOSURES

A. NEMA Type 1.

## 2.4 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. Standard Displays:
  - 1. Output frequency (Hz).
  - 2. Set-point frequency (Hz).
  - 3. Motor current (amperes).
  - 4. DC-link voltage (VDC).
  - 5. Motor torque (percent).
  - 6. Motor speed (rpm).
  - 7. Motor output voltage (V).
- F. Historical Logging Information and Displays:
  - 1. Real-time clock with current time and date.
  - 2. Running log of total power versus time.
  - 3. Total run time.
  - 4. Fault log, maintaining last four faults with time and date stamp for each.
- G. Current-Sensing, Phase-Failure Relays for Bypass Controller: 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.
- H. Multiple parallel loads: Drives serving multiple motors shall be factory equipped with multiple connections and individual motor overload and short circuit protection.

## 2.5 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 VFCs before shipping.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.
- B. Select rating of controllers to suit motor controlled.

### 3.2 INSTALLATION

- A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with VFC mounting surface.
- B. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

### 3.3 IDENTIFICATION

- A. Identify VFCs, components, and control wiring according to Division 16 Section "Basic Electrical Materials and Methods."
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

### 3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices 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 available.
  - 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 control 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.

### 3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
  2. Test continuity of each circuit.
- B. Testing: Perform the following field quality-control testing:
1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including pretesting and adjusting VFCs. Provide all necessary start-up services to program and adjust VFC for each application. Coordinate with controls contractor. A certified start up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.
- 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.

### 3.6 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.7 WARRANTY

- A. Warranty shall be 60 months from the date of certified start-up, not to exceed 66 months from the date of shipment. The warranty shall include all parts, labor, travel time, and expenses.

END OF SECTION

## SECTION 230517-SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.

#### 1.2 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.

3. Metraflex Company (The).
  4. Pipeline Seal and Insulator, Inc.
  5. Proco Products, Inc.
- C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  2. Pressure Plates: Carbon steel.
  3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

### 2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.



1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves.
  2. Exterior Concrete Walls below Grade: Cast-iron wall sleeves with sleeve-seal system.
    - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  3. Concrete Slabs-on-Grade: Cast-iron wall sleeves with sleeve-seal system.
    - a. Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  4. Concrete Slabs above Grade: Galvanized-steel-pipe sleeves. Terminate 2" above finished slab.
  5. Interior Masonry Partitions:
    - a. Rated Partitions: Steel pipe sleeves.
    - b. Non-rated Partitions: Sleeves not required for rigid pipe. Provide PVC sleeves for flexible pipe in non-plenum applications and 16 gauge sheetmetal with rolled edge in plenum applications. Seal all pipe penetrations.

END OF SECTION

## SECTION 230519-METERS AND GAUGES FOR HVAC PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  1. Bimetallic-actuated thermometers.
  2. Liquid-in-glass thermometers.
  3. Thermowells.
  4. Dial-type pressure gauges.
  5. Gauge attachments.
  6. Pitot-tube flowmeters.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  1. Ashcroft Inc.
  2. Ernst Flow Industries.
  3. Marsh Bellofram.
  4. Miljoco Corporation.
  5. Nanmac Corporation.
  6. Noshok.
  7. Palmer Wahl Instrumentation Group.

8. REOTEMP Instrument Corporation.
  9. Tel-Tru Manufacturing Company.
  10. Trerice, H. O. Co.
  11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  12. Weiss Instruments, Inc.
  13. WIKA Instrument Corporation - USA.
  14. Winters Instruments - U.S.
- C. Standard: ASME B40.200.
- D. Case: Liquid-filled type(s); stainless steel with 3-inch nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- G. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- H. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- I. Window: Plain glass or plastic.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus or minus 1 percent of scale range.

## 2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Flo Fab Inc.
    - b. Miljoco Corporation.
    - c. Palmer Wahl Instrumentation Group.
    - d. Tel-Tru Manufacturing Company.
    - e. Trerice, H. O. Co.
    - f. Weiss Instruments, Inc.
    - g. Winters Instruments - U.S.
  3. Standard: ASME B40.200.
  4. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
  5. Case Form: Adjustable angle unless otherwise indicated.
  6. Tube: Glass with magnifying lens and blue or red organic liquid.
  7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
  8. Window: Glass or plastic.

9. Stem: Aluminum and of length to suit installation.
  - a. Design for Air-Duct Installation: With ventilated shroud.
  - b. Design for Thermowell Installation: Bare stem.
10. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
11. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

### 2.3 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

### 2.4 THERMOWELLS

- A. Thermowells:
  1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: CNR or CUNI.
  4. Material for Use with Steel Piping: CRES.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length required to match thermometer bulb or stem.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

### 2.5 PRESSURE GAUGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. AMETEK, Inc.; U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Ernst Flow Industries.
    - d. Flo Fab Inc.
    - e. Marsh Bellofram.
    - f. Miljoco Corporation.
    - g. Noshok.
    - h. Palmer Wahl Instrumentation Group.
    - i. REOTEMP Instrument Corporation.
    - j. Tel-Tru Manufacturing Company.
    - k. Terrice, H. O. Co.
    - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

- m. Weiss Instruments, Inc.
- n. WIKA Instrument Corporation - USA.
- o. Winters Instruments - U.S.
- 3. Standard: ASME B40.100.
- 4. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
- 5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
- 6. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
- 7. Movement: Mechanical, with link to pressure element and connection to pointer.
- 8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
- 9. Pointer: Dark-colored metal.
- 10. Window: Glass or plastic.
- 11. Ring: Metal.
- 12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.6 GAUGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/4 or NPS 1/2 pipe threads.
- C. Valves: Brass ball, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gauge for fluids (except steam).
- I. Install permanent indicators on walls or brackets in accessible and readable positions.

- J. Install connection fittings in accessible locations for attachment to portable indicators.
- K. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
- L. Install thermometers in the following locations:
  - 1.
  - 2. Two inlets and two outlets of each chiller.
  - 3. Inlet and outlet of each boiler.
  - 4. Inlet and outlet of each hydronic coil in air-handling units.
- M. Install pressure gauges in the following locations:
  - 1. Discharge of each pressure-reducing valve.
  - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
  - 3. Suction and discharge of each pump.
  - 4. Inlet and outlet of each boiler.

### 3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow service and maintenance of meters, gauges, machines, and equipment.

### 3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlets and outlets of each chiller shall be one of the following:
  - 1. Industrial-style, liquid-in-glass type.
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
  - 1. Industrial-style, liquid-in-glass type.
- C. Thermometer stems shall be of length to match thermowell insertion length.

### 3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 150 deg F.
- B. Scale Range for Condenser-Water Piping: 0 to 250 deg F.
- C. Scale Range for Heating Hot Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAUGE SCHEDULE

- A. Pressure gauges at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.
- B. Pressure gauges at suction and discharge of each pump shall be one of the following:
  - 1. Liquid-filled, direct-mounted, metal case.

3.7 PRESSURE-GAUGE SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 150 psi.
- B. Scale Range for Condenser-Water Piping: 0 to 150 psi.
- C. Scale Range for Heating Hot-Water Piping: 0 to 150 psi.
- D. Retain one or more of first three paragraphs below. If retaining more than one scale range, indicate location of each on Drawings.

END OF SECTION



## SECTION 230523-VALVES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following general-duty valves:
  - 1. Copper-alloy ball valves.
- B. See Division 23 Section "Direct Digital Controls" for control valves and actuators.
- C. See Division 23 piping Sections for specialty valves applicable to those Sections only.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

#### 1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers are listed below each valve type.

#### 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- D. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- E. Valve Actuators:
  - 1. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.
- F. Extended Valve Stems: On insulated valves.
- G. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- H. Solder Joint: With sockets according to ASME B16.18.
  - 1. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, and globe valves; below 421 deg F (216 deg C) for all ball valves.
- I. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 BALL VALVES:

- A. All ball valves and their components shall be designed for a minimum working pressure of 600 PSI WOG and conform to MSS-SP-110. All non-metallic components and elastomers shall be suitable for 250 degrees F minimum continuous operating temperature, or not less than 50 degrees F above the operating temperature of the system, whichever is higher. All mating surfaces of closure faces shall be of bronze or Type 300 series or 17-4PH stainless steel, or elastomer, approved for the particular service, and materials must be compatible to prevent poisoning of contact surfaces of different materials (electrolytic action). Each valve shall be provided with a handle or wheel which shall be secured to the stem or chained to the valve body.
- B. Ball valves on lines 2-1/2 inches and smaller. Valves shall have bronze bodies with chrome-plated balls, threaded ends, and shall conform to MSS SP-110. Valves may be 2-piece or 3-piece bolt-through body. Valves used in runouts to room heating and cooling units may have sweated ends or compression type fittings. Valves used for balancing shall have balancing / memory stops included with valve. Use stem extensions on all insulated lines. Valves shall be RED-WHITE 5544/5549 OR EQUALS BY NIBCO, HAMMOND or CRANE.
- C. Ball valves 4"-8" shall be 2-piece, full port, epoxy coated cast iron body, with Teflon infused metal ball or stainless ball. American Valve model 3700 or equal."

## 2.4 BUTTERFLY VALVES

- A. Butterfly valves may be used on lines larger than 8". Valves shall be structurally designed to provide closure against the system operating pressure. Valve shaft shall be of Type 316, 416 or 17-4PH stainless steel. Shaft seals shall be of the "O" ring type. Stems, discs and operators shall be designed for a water velocity of 16 feet per second through the nominal pipe area. Bodies shall be lugged or flanged type. Valves flanges shall be of the same class as required for the lines in which they are installed. Valves 8 inches and larger shall be provided with enclosed worm gear type operators permanently lubricated. Valves which serve to isolate

system to permit removal of equipment shall have bodies with integral flanges, or full lugs drilled and tapped, to hold valve in place when piping or equipment is removed, and be capable of dead-end service to 150 PSI without use of the downstream flange. Valves installed with mechanical couplings shall be grooved or shouldered ends suitable for the approved couplings. Valves in insulated lines shall have extended necks to extend a minimum of 1" beyond the insulation and jacket.

## 2.5 NON-SLAMMING CHECK VALVES

- A. Non-slamming or silent check valves shall be of the fully guided conical type, torsion spring actuated, or cone and diaphragm type. Bodies shall be constructed of cast iron, cast steel, stainless steel, or cast bronze in accordance with the following specifications:
  - 1. Cast Iron: ASTM A-126 Class B or ASTM A-48 Class 35.
  - 2. Cast Steel: ASTM A-216 Class WCB.
  - 3. Cast Bronze: ASTM B-61 or ASTM B-584.
- B. Seats and discs shall be constructed of bronze complying with ASTM B-62 or ASTM B-584 with torsion springs constructed of 300 series or 18-8 stainless steel. Seats may be of an elastomer suitable for 250 degrees F minimum continuous operating temperature, or not less than 50 degrees F above the operating temperature of the system, whichever is higher. All mating surfaces of the closure faces shall be of bronze or Type 304, 316, or 17-4PH stainless steel, or elastomer, approved for the particular service, and materials must be compatible to prevent electrolytic action. Pressure loss through the valves, measured in feet of water, shall not exceed six tenths of the water velocity in feet per second.
- C. Non-slamming check valves shall provide bubble-tight shutoff when handling water up to 250 degree F, and shall be designed to prevent rubbing of seat material when opening and closing. Poppet type valves shall have conical springs.

## 2.6 AUTOMATIC FLOW CONTROL VALVES

- A. Automatic Flow control valves: 150-psig working pressure, 250 deg F maximum operating temperature, and having threaded ends. Valves shall be capable of automatically controlling within  $\pm 5\%$  accuracy. Four operating ranges shall be available with a maximum 2 psid required to control to design flow. Valve shall be equipped with P/T test valves on both sides of the unit. Provide strainer and isolation valves unless these items are already provided as part of a control valve assemble.

## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
  - 1. Shutoff Service:
    - a. 8" and smaller –Ball valves.

- b. 10" and larger – Butterfly valves.
  2. Pump Discharge: Spring-loaded, non-slamming check valves.
  3. System Balancing and Equipment Flow Control: Automatic flow control valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Valves shall be Class 125 (125 PSI SWP / 200 PSI WOG) or 150 percent of the system operating pressure, whichever is the greater.

### 3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support for valves over 12".
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install check valves for proper direction of flow.

### 3.3 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- 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. Use silver soldered joints for all chilled and hot water piping applications.

### 3.4 ADJUSTING

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

END OF SECTION

## SECTION 230529-HANGERS AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. See Division 23 Section "Mechanical Vibration Controls" for vibration isolation supports and hangers

Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

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

#### 2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components.
  - 1. Manufacturers:
    - a. B-Line Systems, Inc.

- b. Grinnell Corp.
    - c. Michigan Hanger Co., Inc.
  2. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
  3. 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. Manufacturers:
    - a. B-Line Systems, Inc.
    - b. Grinnell Corp.
    - c. Michigan Hanger Co., Inc.
    - d. Unistrut Corp.
  2. Coatings: Manufacturer's standard galvanized finish
  3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
  1. Material for insulated Piping: ASTM C 552, Type I cellular glass water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
  2. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
  3. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
  4. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 MISCELLANEOUS MATERIALS

- A. Not 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, non-shrink and non-metallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Non-staining, noncorrosive, and nongaseous.

3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 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. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  3. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  4. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 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.
- 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-joist construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Not used.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
  2. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi 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-deg ree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  3. 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.

### 3.2 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. 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. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from



ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

- D. Install building attachments within concrete slabs or attach to structural steel. 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 mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal 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.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. 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.
- J. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Insulated Piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - b. Do not exceed pipe stress limits according to ASME B31.9.
    - c.
  - 2. Not used.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
  - 5. Pipes NPS 6 and Larger: Include treated 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. 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. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

## SECTION 230548-MECHANICAL VIBRATION CONTROLS

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
1. Elastomeric isolation pads and mounts.
  2. Freestanding and restrained spring isolators.
  3. Housed spring mounts.
  4. Elastomeric hangers.
  5. Spring hangers with vertical-limit stops.
  6. Thrust limits.
  7. Pipe riser resilient supports.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Not used.

#### 1.3 SUBMITTALS

- A. Product Data: Include load deflection curves for each vibration isolation device indicated.

#### 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

#### 2.2 VIBRATION ISOLATORS

- A. 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: Standard neoprene.
- B. 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.
- C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with 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.
- D. 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.
- E. 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.
- Coil Spring: Factory set and field adjustable for a maximum of 1/4" movement at start and stop.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install roof curbs, equipment supports, and roof penetrations as specified in Section "Roof Accessories."
- B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
- C. 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.
- D. 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.
- E. Install resilient bolt isolation washers on equipment anchor bolts.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Test isolator deflection.
  - 2. Inspect minimum snubber clearances.

### 3.3 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 (6-mm) movement during start and stop.
- D. Adjust active height of spring isolators.
- E. Adjust snubbers according to manufacturer's written recommendations.

END OF SECTION 23548



## SECTION 230553-MECHANICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 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. Valve tags.

#### 1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

#### 1.3 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.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive or affix with stainless steel screws.

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.

## 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.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

## 2.3 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. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch-thick brass.
2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 23 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, compressors, chillers, condensers, and similar motor-driven units.
  2. Coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  3. Fans, blowers, primary balancing dampers, and mixing boxes.
  4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive or stainless steel screws 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. Meters, gages, thermometers, and similar units.
    - b. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - c. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - d. Fans, blowers, primary balancing dampers, and mixing boxes.
    - e. Packaged HVAC central-station and zone-type units.

### 3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
  2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
  3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
  4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

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 non-concealed 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 non-accessible 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 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. 1-1/2 inches (38 mm), round.
2. Valve-Tag Color:
  - a. Cold Water: Blue.
  - b. Gas: Yellow .
  - c. Condenser Water: Green
  - d. Heating hot water: Red
3. Letter Color:
  - a. All Piping: White.

### 3.5 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification.

END OF SECTION

## SECTION 230593- TESTING, ADJUSTING, AND BALANCING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow 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 activities and procedures specified in this Section.

B. Testing and balancing services shall be provided by an AABC, NEBB or TABB certified contractor specializing in testing and balancing services. The testing and balancing contractor's services shall be provided and paid for by the contractor.

#### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. AMCA: Air Movement and Control Association.
- C. NEBB: National Environmental Balancing Bureau.
- D. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

#### 1.3 SUBMITTALS

A. Strategies and Procedures Plan: Testing, adjusting, and balancing strategies and step-by-step procedures. Include a complete set of report forms intended for use on this Project.

B. Certified Testing, Adjusting, and Balancing Reports: Prepared on approved forms certified by the testing, adjusting, and balancing Agent.

#### 1.4 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify 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 testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

## 1.5 PROJECT CONDITIONS

- A. 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.

## 1.6 COORDINATION

- A. Coordinate 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. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the 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. 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 devices 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 equipment performance data, including fan 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 performance ratings of HVAC equipment when installed under conditions different from those presented when 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 design data and installed conditions.
- E. 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.
- F. Examine system and equipment test reports.
- G. 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.
- H. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- I. 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.
- J. Examine terminal units, such as mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- K. Examine plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine open-piping-system pumps to ensure absence of entrained air in suction piping.

- N. Examine equipment for installation and for properly operating safety interlocks and controls.
- O. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices operate by the intended controller.
  - 2. Dampers, valves and other controlled devices are in the position indicated by the controller.
  - 3. Integrity of dampers, valves and other controlled devices for free and full operation and for tightness of fully closed and fully open positions.
  - 4. Thermostats, humidistat, and other controllers and sensors are located to avoid adverse effects of sunlight, drafts, and cold walls.
  - 5. Sensors are located to sense only intended conditions.
  - 6. Sequence of operation for control modes is according to the Contract Documents.
  - 7. 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.
  - 8. Interlocked systems are operating.
  - 9. Changeover from heating to cooling mode occurs according to design values.
- P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures. Provide the deficiencies with report.

### 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. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolation and balancing valves are open.
  - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 7. Windows and doors can be closed so design conditions for system operations can be met.

### 3.3 TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to procedures contained in AABC national standards. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- 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.
- D. As a part of the work of this contract, the Contractor shall make any adjustments and/or replacement of the pulleys, belts, and dampers (or the addition of dampers required for correct balance) as recommended by the Air Balance and Testing Agency, at no additional cost to the Owner.
  - 1. For fan motors 5 HP and above:
    - a. At no additional cost to the Owner, install variable pitch pulleys on the fan motors, to facilitate fan speed adjustments, during the balancing period only.
    - b. Upon completion of the testing and before final inspection, install fixed drive and driven pulleys and belts of the required size, as determined during the testing period.
  - 2. For fan motors smaller than 5 HP:
    - a. Upon completion of the testing and before final inspection, install variable pitch drive and driven pulleys and belts of the required size, as determined during the testing period.
  - 3. The pulleys and belts supplied with the fan may or may not be the right size. In no case, reduce the manufacturer required number of belts.
  - 4. All belt driven fans shall have their speeds adjusted and drives changed where necessary so that the fans deliver design CFM at actual static pressure developed by the installed system.
  - 5. For fan motors with variable speed drives on constant air flow systems, such as fractional horsepower exhaust fans, using the variable speed controller supplied with the fan, adjust the fan speed as required to obtain the design CFM against the actual system static pressure developed by the installed system.
  - 6. For fans with variable frequency drives (V.F.D.'s), using the V.F.D. adjust the fan speed as required to obtain the maximum design CFM against the actual system static pressure developed by the installed system. If the fan V.F.D. is running at less than 55 hertz, change the fan drive where necessary so that the fan delivers design CFM at the actual static pressure developed by the installed system, with the V.F.D. running at 60 hertz.

### 3.4 TOLERANCES

- A. Set HVAC system airflow rates within the following tolerances:
  - 1. Supply and Return Fans: Minus 5 to plus 5 percent.
  - 2. Exhaust Fans: 0 to minus 5 percent.
  - 3. Supply and Return Air Outlets and Inlets: Minus 10 to plus 10 percent
  - 4. Exhaust Air Outlets and Inlets: 0 to minus 10 percent

### 3.5 REPORTS

A. 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.

B. Final Report: Typewritten, or computer printout in letter-quality font, on standard bond paper, bound in three-ring, loose-leaf binder, and tabulated and divided into sections by tested and balanced systems.

1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Final Report Contents: In addition to certified field report data, include the following that applies:
  - a. Fan curves.
  - b. Pump curves.
  - c. Valve Cv's
  - d. Manufacturers' test data.
  - e. Field quality-control test reports prepared by system and equipment installers.
  - f. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
4. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - a. Title page.
  - b. Name and address of testing, adjusting, and balancing Agent.
  - c. Project name.
  - d. Project location.
  - e. Architect's name and address.
  - f. Engineer's name and address.
  - g. Contractor's name and address.
  - h. Report date.
  - i. Signature of testing, adjusting, and balancing Agent who certifies the report.
  - j. Summary of contents, including the following:
    - 1) Design versus final performance.
    - 2) Notable characteristics of systems.
    - 3) Description of system operation sequence if it varies from the Contract Documents.
  - k. Nomenclature sheets for each item of equipment.
  - l. Data for terminal units, including manufacturer, type size, and fittings.
  - m. Notes to explain why certain final data in the body of reports vary from design values.
  - n. Test conditions for fans and pump performance forms, including the following:
    - 1) Settings for outside-, return-, and exhaust-air dampers.
    - 2) Conditions of filters.



- 3) Cooling coil, wet- and dry-bulb conditions.
  - 4) Face and bypass damper settings at coils.
  - 5) Fan drive settings, including settings and percentage of maximum pitch diameter.
  - 6) Inlet vane settings for variable-air-volume systems.
  - 7) Settings for supply-air, static-pressure controller.
  - 8) Other system operating conditions that affect performance.
5. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
- a. Quantities of outside, supply, return, and exhaust airflows.
  - b. Duct, outlet, and inlet sizes.
  - c. Terminal units.
  - d. Balancing stations.

### 3.6 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.

END OF SECTION



## SECTION 230713-DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes semirigid and flexible duct, insulating cements, field-applied jackets, AND accessories and attachments.

#### 1.2 SUBMITTALS

- A. Product Data: Thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Shop 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.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

### 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. Certain Teed.
    - b. Knauf Insulation
    - c. Owens-Corning Fiberglass Corp.
    - d. Johns Manville

## 2.2 INSULATION MATERIALS

- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 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, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
- C. Field-Applied Jackets: ASTM C 921, Type 1, unless otherwise indicated.
  - 1. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  - 2. PVC jacket: High-impact, ultraviolet-resistant PVC; 20 mils(0.5mm) thick; roll stock ready for shop or field cutting and forming.
- D. Accessories and Attachments:

## 2.3 ADHESIVES

- 1. 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).
- 2. 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.
- 3. 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.

## PART 3 - EXECUTION

### 3.1 GENERAL APPLICATION REQUIREMENTS

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application including all dust, dirt and particulates.
- B. Site Preparation: The installation area shall be enclosed and weather proof during and after installation to prevent moisture intrusion. If insulation is water damaged, all affected insulation shall be removed and replaced with new materials. The contractor shall report in writing any incident of water damage to the design professional.

- C. 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.
- D. 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.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- G. Apply insulation with the least number of joints practical.
- H. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- I. 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.
- J. 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.
- K. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
- L. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- M. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations. Extend insulation 6" onto wall and seal edge with mastic unless visible.
- N. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.

### 3.2 DUCT AND PLENUM APPLICATION SCHEDULE

Unless noted otherwise duct insulation shall be as follows:

- A. Service: supply-air, return-air, and outside-air ducts, concealed. Externally wrap.
  - 1. Material: Mineral-fiber board or Mineral-fiber blanket.
  - 2. Thickness: 2 inches.
  - 3. Number of Layers: One.
  - 4. Field-Applied jacket: Foil and paper.
  - 5. Vapor Retarder Required: Yes.

- B. Service: supply-air, return-air, and outside-air ducts, exposed to ambient. Internally lined.
  - 1. Material: 3 pcf duct liner with high density internal face, closed cell flexible elastomeric.
  - 2. Thickness: 1 inches.
  - 3. Number of Layers: One.

END OF SECTION

## SECTION 230719 - PIPE INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes semirigid and flexible piping insulation, insulating cements, field-applied jackets, accessories and attachments, and sealing compounds.

#### 1.2 SUBMITTALS

- A. Product Data: Thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Shop 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.

#### 1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.
- B. Insulation shall be installed by a firm whose principal business is the application and installation of thermal insulating material on piping and duct systems, with a minimum of five years' experience in this principal business. Materials shall be installed by skilled mechanics in accordance with manufacturer's standard published instructions except as otherwise specified.
- C. ASBESTOS FREE INSTALLATION: All insulation and insulation materials shall be certified asbestos free. After the installation is complete, all insulation shall be labeled "ASBESTOS FREE INSULATION". The labels shall be positioned so that the labels will not be visible to a person standing on THE floor. The labels shall be fully adhered to The jacket or surface of The insulation so that The labels are not easily removed. The labels shall be located at least 10 foot on center and at each change of direction of The pipe or duct. All equipment that is insulated shall be labeled "ASBESTOS FREE INSULATION" as above. Labels shall be blue with 3/4" high white letters.
- D. Provide 20-year manufacturer's limited warranty on the insulation efficiency, moisture absorption, compressive strength, dimensional stability and combustible properties of the installed system for indoor chilled water piping. If any of the above listed fails to meet the

specified and/or installed value during the warranty period replacement insulation of equal or better quality shall be provided at no cost to the owner. The contractor shall bear the cost of all factory recommended installation procedures and factory inspections required to provide a factory approved installation.

## 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:
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.
  - 3. Foamglass insulation
    - a. Pittsburgh Corning
    - b. Cell-U-Foam

### 2.2 PIPE 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. 3/4 pcf density, type 75 insulation with ASJ. Secure joints with galvanized staples and 2-1/2" pressure sensitive foil tape.
  - 3. Preformed pipe insulation with wicking core: Comply with ASTM C 547, Type I, with factory applied jacket with factory cut evaporation holes. Wicking core shall be continuous along all lengths of pipe and across all fittings. Installed system shall be laboratory tested to maintain indefinite insulation dryness without dripping for the service listed under ambient conditions of 90 deg F, 90% relative humidity.
  - 4. Fire-Resistant Adhesive: Comply with MIL-A-3316C Class 1, Grade A for bonding glass cloth and tape to un-faced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to un-faced glass-fiber insulation.
  - 5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  - 6. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  - 7. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
  - 8. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. 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.



- C. Cellular Glass Insulation: Closed-cell, 100% rigid cellular glass. Comply with ASTM C 552, Type II, in 18" or 24" sections factory fitted for the vessel size.
  - 1. Joint Sealant: Permanently resilient styrene-butadiene rubber sealant as recommended by manufacturer.
  
- D. Field-Applied Jackets: ASTM C 921, Type 1, unless otherwise indicated.
  - 1. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  - 2. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
  - 3. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultraviolet-resistant PVC.
  - 4. Aluminum Jacket: Aluminum jacketing, .016" thickness with bands and seals of same material.
  
- E. Accessories and Attachments:
  - 1. Fiberglass insulation Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, pre-sized a minimum of 8 oz./sq. yd.
  - 2. Bands: 3/4 inch wide, .016 inch thick, aluminum. Tie wire is not acceptable.

### PART 3 - EXECUTION

#### 3.1 GENERAL APPLICATION REQUIREMENTS

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
  
- B. Site Preparation: The installation area shall be enclosed and weather proof during and after installation to prevent moisture intrusion. If insulation is water damaged, all affected insulation shall be removed and replaced with new materials. The contractor shall report in writing any incident of water damage to the design professional.
  
- C. 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 pipes and fittings.
  
- D. Use accessories compatible with insulation materials and suitable for the service indicated. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
  
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder. Do not use joint sealants to fill voids in excess of 1/8".
  
- F. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer. Joint voids shall not exceed 1/8".
  
- G. Apply insulation with the least number of joints practical.

- H. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- I. 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. Provide cellular glass blocking and saddles at support points.
- J. 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.
- K. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
- L. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions except fire-rated walls and partitions. Foam glass insulation shall be continuous through rated walls with a UL listed fire stop assembly.
- M. Floor Penetrations: Apply insulation continuously through floors, except rated floor assemblies. Foam glass insulation shall be continuous through rated floors with a UL listed fire stop assembly.
- N. Grooved Piping: Insulation applied to grooved piping systems shall be of the material and thickness specified and factory formed to match the fittings. Field cut insulation is not acceptable.

### 3.2 PIPE INSULATION APPLICATION SCHEDULE

- A. Service: Refrigerant suction and liquid piping.
  - 1. Insulation Material: Flexible elastomeric.
  - 2. Insulation Thickness: 1"
  - 3. Field-Applied Jacket: Provide UV protective finish on all exterior insulation  
Vapor Retarder Required: No.
  
- B. Service: Condensate drain piping.
  - 1. Insulation Material: Flexible elastomeric.
  - 2. Insulation Thickness: 1/2"
  - 3. Condensate piping routing horizontally in concealed spaces above ceilings, in walls etc., shall be flame-spread 25, smoke-developed 50, according to ASTM E 84.

END OF SECTION

## SECTION 230800-HVAC FUNCTIONAL CHECK OUT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section includes the functional check out (FCO) of the HVAC systems to ensure proper operation and control in all modes of operation. HVAC systems installed under this contract are to be inspected, tested, signed off as complete and operational, and operated for functional check out agency verification as described in Part 3 of this Section. This includes, but is not necessarily limited to the work listed. The HVAC system will not be considered substantially complete until such time that the functional check out procedure is complete.
- B. The intent of the FCO is to verify that the HVAC system is performing as intended and in no way is the FCO intended to supplant the contractor's responsibility of verifying that the HVAC system is complete and operable including all troubleshooting, T&B and control commissioning work.
- C. The functional checkout services shall be performed by an independent commissioning agent. The agencies services shall be included in the base contract.
- D. Functional check out services are to be provided in four (4) stages: pre-construction, construction by phase, acceptance, and post-acceptance as outlined in part 3 of this section.
- E. The construction stage of each phase shall be completed in that phase. FCO of systems serving multiple phases shall be performed upon the completion of all phases served by that system. A partial report shall be provided upon the completion of each construction phase and a comprehensive report provided upon substantial completion.

#### 1.2 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a certified commissioning agent.
- B. All procedures shall be in accordance with the AABC Commissioning Group Guidelines.

### PART 2 - PRODUCTS

#### 2.1 PRODUCTS (Not Applicable)

### PART 3 - EXECUTION

#### 3.1 FUNCTIONAL CHECK OUT AGENCY RESPONSIBILITIES:

- A. General: The functional check out agency, hereafter referred to as the agency or agent, is responsible for coordinating all functional check out activities and maintaining written records.

All records shall be submitted to the Engineer with copies distributed to the Architect and Contractor.

- B. It is the Agency's responsibility to provide written verification that each phase of the FCO is complete before proceeding with the next phase.
- C. During the preconstruction phase the functional checkout agent shall carry out the following scope of work:
1. Review the design documents (drawings and specifications) to ensure inclusion of material covering the Contractor's responsibilities for functional check out; provide comments and suggestions for designer consideration.
  2. Prepare the construction-phase functional check out plan. The FCO plan shall include an itemized check sheet of all HVAC systems and the required verification data for those systems. At a minimum, the FCO plan shall address each sequence and set point for all HVAC systems including set points and system. The FCO plan shall also include a schedule for the FCO activities. Refer to documentation section for additional information on FCO plan. The FCO plan shall be submitted to the design team for review.
  3. Schedule a pre-construction meeting with the Architect, Engineer, Mechanical Subcontractor, and Contractor to review FCO plan and design document review comments.
  4. Provide a written report of pre-construction activities including the following:
    - a. Proposed revisions or clarifications.
    - b. List all required submittal and shop drawing data required for agent review.
    - c. Approved FCO plan.
- D. During the construction phase the agency shall carry out the following scope of work:
1. Organize and direct the functional check out team in executing the FCO plan. The agency shall schedule and document all functional checkout activities.
  2. Review shop drawings and equipment submittals for information affecting the functional check out process. Provide a written review.
  3. Update the functional check out plan to reflect equipment and controls data from the submittals, and provide functional check out schedule information that the Contractor can integrate into the project schedule.
  4. Schedule and lead functional check out meetings.
  5. Establish and maintain a system for tracking issues needing resolution.
  6. Review the project schedule periodically to ensure functional check out activities are properly incorporated.
  7. Perform on-site observations during construction and provide written observation reports.
  8. Monitor correct component and equipment installation; including controls point-to-point checkouts. Document all observations.
  9. Witness equipment and system start-ups and review Contractor documentation of procedures.
  10. Provide written report of construction phase activities including all items required in the functional check out plan.
- E. During the acceptance phase the agency shall carry out the following scope of work:
1. Review the as-built documents and address any concerns in writing.
  2. Review the test and balance report and provide a written response identifying any issues or concerns. Field performance testing shall not commence until the testing and balancing process is substantially complete including Engineer review and acceptance of the final testing and balancing report.

3. Coordinate functional performance testing of sub-systems, systems, and interactions between systems, leading to acceptance of the completed work. All HVAC systems shall be operated in every mode until such point that the system stabilizes. Document results on FCO check sheets.
  4. Measure and record space, and equipment operating dry and wet bulb temperatures during functional tests and compare to control system set points and sensor readings.
  5. Upon completion of the acceptance phase the agency shall schedule a final acceptance meeting to be attended by the Engineer, Contractor, and Subcontractors. The purpose of the meeting is to verify that all parties are in agreement that the acceptance phase is complete and all systems are performing as intended.
- F. During the post-acceptance phase the agency shall carry out the following scope of work:
1. Conduct functional performance testing of sub-systems, systems, and interactions between systems that could not be carried out prior to acceptance.
  2. Prepare and submit a final functional check out report. The report shall provide definitive acceptance or rejection of each HVAC system along with a detailed recount of any remaining deficiencies.
  3. The agency shall attend and review the owner O&M training and documentation to ensure that the owner is provided with the practical knowledge required to operate and maintain the HVAC system.

### 3.2 CONTRACTOR RESPONSIBILITIES

- A. This Section of the specifications defines the Contractor's responsibilities with respect to the functional check out process. The Contractor and Subcontractors shall review this Section, and shall include in their bids for carrying out the work described, as it applies to each Division and Section of these specifications, individually and collectively. The FCO is intended as an addition to the construction process and it remains the Contractor's sole responsibility to provide a complete and operable HVAC system.
- B. The Contractor shall assign a representative to the FCO team, and submit the person's name to the FCO agency, within one (1) month of the award of the contract. The representative shall have the authority to make decisions on behalf of the Contractor as they relate to the organization and scheduling of HVAC FCO. The representative shall facilitate communications among all Contractors and suppliers and other team members, and shall foster the necessary cooperative action. One specific responsibility shall be to attend FCO meetings, and ensure action items arising from them are attended to as required to allow the FCO process to proceed on schedule.
- C. The Contractor, Mechanical Subcontractor, all Division 15 Subcontractors, and the Electrical Contractor shall be responsible for cooperating, and coordinating their work, with the Agency. They shall also be responsible for carrying out all the activities required for installation of components and systems, and operating them during the functional check out process as required in this Section.
- D. In the event that any scheduled equipment or system start-ups or functional performance tests are terminated because the agency or designer discover deficient or incomplete work, or due to the non-attendance of required Contractor or supplier personnel, the Contractor or Subcontractor responsible for the termination shall also be responsible for paying reasonable costs of time and travel expenses of any or all of the following representatives who were physically present for the purpose of witnessing the FCO activity: the agency, engineer, and the

owner. The agent shall provide a statement to the Contractor identifying the specific activity that was terminated, the scheduled date, and a list of those in attendance, along with their reasonable time and travel expense costs.

- E. During the preconstruction phase the Contractor shall carry out the following scope of work:
1. Provide the functional checkout agency with a all mechanical shop drawings, equipment and control submittals and other pertinent information requested by the agency. It is the Contractor's responsibility to provide the Agency a copy of the approved shop drawings after review by the design team.
  2. Participate in the pre-construction meeting.
  3. Provide a written response to the Agency's pre-construction report identifying proposed changes that represent a change in scope requiring a change proposal. Failure to respond will be interpreted as acceptance of the Agency's proposed changes.
  4. Incorporate the agents FCO scheduling information into the construction schedule and provide scheduling information to the Agency for those milestones included in the FCO plan that are the responsibility of the Contractor (i.e. pressure tests, equipment start up, etc.).
- F. During the construction phase the Contractor shall carry out the following scope of work:
1. Cooperate and participate in FCO activities in accordance with FCO plan. Incorporate the FCO plan milestones into the project schedule. Keep the Agency abreast of any scope or schedule revisions that would impact the FCO plan and provide a minimum 2-week advance notice to the agency, engineer and owner for scheduled activities.
  2. Implement approved revisions proposed during pre-construction phase.
  3. Facilitate and document all tasks outlined in the construction phase FCO plan that are charged to the Contractor.
  4. Provide full start up of the HVAC and control systems to verify that the system is complete and operable prior to FCO acceptance phase.
- G. During the acceptance phase the Contractor shall carry out the following scope of work:
1. The Contractor shall perform basic HVAC functional tests to ensure that all equipment is functioning properly prior to the formal performance FCO.
  2. Perform the functional performance testing of sub-systems, systems, and interactions between systems to be witnessed and documented by the Agency. All HVAC systems shall be tested in every mode of operation such that the control, sequencing and capacity of the HVAC systems is proven to be stable and in accordance with the design intent. For the purpose of testing it may be necessary to modify the system set points to trigger the sequences of operation. The functional performance tests shall progress from the individual subsystems to the larger systems for ease of identifying potential problems.
  3. The Contractor shall involve the necessary Subcontractors including, but not limited to, HVAC, electrical, sheet metal, controls, and test and balancing. Each Subcontractor shall make available the necessary personnel to identify and address any aspects of the HVAC system that require repair or adjustment during the functional check out.
  4. The Contractor shall make whatever repairs or revisions are necessary to achieve system performance in accordance with the construction documents and subsequent approved revisions in a timely fashion and at no additional cost to the owner.
- H. During the post-acceptance phase the agency shall carry out the following scope of work:
1. Provide the FCO agent with a complete set of as-built documents including HVAC equipment, duct work and controls.
  2. Provide the owner with the required O&M training and documentation.

### 3.3 DOCUMENTATION

- A. Functional Check Out Plan: The FCO plan shall list all scheduled activities, milestones and the requirements, time line and responsible party for each respective task. The FCO plan shall be developed by the agency with Engineer approval prior to release. At a minimum the plan shall include the following:
1. Required meetings: At a minimum, the FCO team shall hold pre-construction, pre-control commissioning, pre-T&B, pre-verification and final verification meetings. Additional progress meetings shall be scheduled or called as required for coordination purposes.
  2. Milestones: Include all construction milestones and required documentation thereof including but not limited to duct pressure testing, hydronic system testing, mechanical equipment installation, T&B, controls commissioning and overall HVAC system performance verification.
  3. Required submittals and shop drawings: Include a complete list of all required submittals that the Contractor will supply to the agency.
  4. Functional check out report requirements: A FCO report form is required for each individual HVAC system. The report form shall outline the tasks in a format according to the AABC Commissioning Group System Verification and Start up check lists.
  5. Acceptance phase verification requirements: For each HVAC system identify the verification process for the modes of operation and the specific points to be verified during acceptance. Provide a written form for each HVAC system to be completed during the acceptance phase and included in the final report.
- 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.
- C. Performance Test Report Data: Performance Test Report Data shall follow a Test and Balance report format showing the design, actual and control system readings for all control and input points. Separate reports shall be provided for each system under all modes of operation. The space conditions shall also be monitored (representative samples are acceptable for large systems) for each mode of operation.
- D. Final Acceptance Report: The final acceptance report shall include final documentation of all items addressed in the FCO plan. The report shall not be submitted until the FCO process is complete and accepted by the agency.

### 3.4 ADDITIONAL TESTS

- A. Within 90 days of completing the functional check out, perform additional testing to verify that the system remains in proper operating condition. The agency shall provide an additional site visit between 60-90 days post final acceptance to take sample readings to verify continued performance of the HVAC system.

END OF SECTION





## SECTION 230923 - DIRECT DIGITAL CONTROL SYSTEM

### PART 1 - GENERAL

#### 1.1 OVERVIEW

- A. The Direct Digital Controls (DDC) section shall be part of the General Contractors scope of work.
- B. The DDC scope shall include the migration of the existing Novar system to a current DDC head end controller and the integration of the new building HVAC controls into a common system. Local and remote user interface to the extent specified herein shall be provided through the single control system.
- C. The existing Novar SAVVY or Lingo XE head end controller shall be replaced with a new head end controller pre-programmed with licensed Novar drivers and migration software. The new controller shall be capable of uploading and converting the existing Novar programs and graphics to provide a seamless migration.
- D. Furnish a totally native BACnet-based system with a Tridium software platform . The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2008, BACnet.
- E. The new head end controller shall include BACnet drivers and communication bus required to communicate with new building VRF and DOAS packaged units.
- F. The DDC control system shall provide monitoring and control of all HVAC systems as specified herein through a single system interface. All scheduling, set points, monitored points and alarms shall be mapped to and accessible through the DDC system. Interactive graphics shall be provided for all new and existing HVAC systems.
- G. The DDC Contractor shall coordinate this scope of work with all related trades, such as, but not limited to, the Mechanical, Electrical and Special Systems Contractors.
- H. Any proposed problems, deviations or changes from the plans and / or specifications, shall be communicated to the General Contractor, for the Architect, Engineer and the Owners approval.
- I. All DDC controls shall be in strict accordance with HVAC equipment manufacturer's requirements. Verify all sequences and control parameters with equipment manufacturer prior to submittal.
- J. All HVAC system controls provided by the equipment manufacturer shall be provided with a BacNet interface to make available all points necessary to control and monitor the system. The points list shall include, but is not limited to, all points listed in the sequences of operation.
- K. DDC Subcontractor shall provide:
  - 1. A fully integrated direct digital control (DDC) system for control of all HVAC systems and other systems outlined herein.

2. All tubing, wiring, conduit, and panels for the DDC and temperature controls equipment shall be by this subcontractor. Line voltage wiring and control transformers for control power will be by this subcontractor from the control power disconnect provided by or air terminal device manufacturer. Coordinate the control transformer voltage with the available power source provided by or air terminal device.
3. All temperature control wiring and conduit and final electrical terminations to each control system sensor, transducer, application specific controller and main control panel shall be by the DDC subcontractor.
4. All temperature control wiring and conduit and final electrical terminations as required for the full operation of the DDC system. Coordinate delineation of scope between DDC systems and proprietary equipment control systems to ensure a complete and operable system. It is incumbent upon the contractor to coordinate the division of work between subcontractors.
5. All existing system software and hardware upgrades necessary to communicate with and control the new controls.
6. All software and hardware accessories required by balancing contractor for commissioning all air and water systems. Software and hardware may be provided on a temporary basis until job is completed. The balancing contractor is responsible for providing a laptop computer with modem port.
7. All isolation relays necessary to monitor other control systems.
8. With the exception of wiring above suspended ceilings, all wiring shall be run in conduit or EMT. Any exposed wiring within plenum spaces shall be plenum rated.

## 1.2 GENERAL SYSTEM

- A. This specification is intended to provide for decreased energy consumption, energy demand control, maintenance cost, as well as, increase in comfort conditions, reliability and operational control. The system shall consist of field control modules that utilize true Distributed Processing Architecture (DPA) and Direct Digital Control (DDC) Technology, linked together by a Local Area Communication Network (LAN).
- B. All modules shall be capable of stand-alone operation in the event of communications failure.
- C. The System architecture shall consist of four (4) levels:
  1. User interface via web based access for local and remote users,
  2. Building Level Network Manager (central head end),
  3. Universal Input / Output Modules,
  4. Electronic Thermostats / Unitary Controllers / VAV Controllers.
- D. This DDC system shall communicate with the existing Remote Host Computers utilizing the existing Novar Engineering / Support System Software, located in the Covington and Slidell, Louisiana maintenance departments via the existing either-net.
- E. The new DDC system shall include a five (5) year warranty covering materials, labor and expenses such that all warranted repairs are cost free to the owner during the warranty period.

## 1.3 CONTRACTOR QUALIFICATIONS

- A. The FMS subcontractor shall have been in the business of furnishing, installing and servicing the same product line for a minimum of ten (10) years and have a local

factory authorized sales and service office within 50 miles of the St. Tammany Parish School Board office. The FMS subcontractor shall be a factory authorized sales and service office in the Parish of St. Tammany for the FMS manufacturer. Dealers and distributors of a listed FMS manufacturer are not approved to bid.

1.4 QUALITY ASSURANCE:

- A. Materials and equipment shall be cataloged products of manufacturers regularly engaged in production and installation of Facility Management systems and shall be of the manufacturer's latest standard design. Single source responsibility of the supplier shall be the proper operation of the FMS. This shall include software debugging and proper calibration of each component. The FMS contractor shall coordinate with the mechanical equipment supplier to ensure that the all equipment is compatible with the controls to provide a complete and operable system. The FMS contractor is responsible for any ancillary items necessary for an operable system.
- B. The FMS manufacturer shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- C. All FMS equipment shall conform to the requirements of FCC regulation, Part 15, Section 15 governing radio frequency electromagnetic interference.
- D. The FMS shall comply with UL 916 and be so listed at the time of bid.
- E. Design and build all system components to be fault-tolerant.
- F. Satisfactory operation without damage at 110% and 85% of rated voltage.
- G. Static, transient and short-circuit protection on all inputs and outputs.
- H. Network-connected devices shall be A.C. coupled, or equivalent such that any single device failure does not disrupt network communication.
- I. All real time clocks and data file RAM shall be battery-backed for a minimum seventy-two (72) hours.

1.5 DOCUMENTATION:

- A. Submittal and FMS shop drawings: submit manufacturer's data on Facility Management system and components, and shop drawings. Refer to general conditions for submittal requirements.
- B. Wiring diagrams: submit flow, signal, point to point and control wiring diagrams for Facility Management system using CAD generated drawings. Supply diskettes upon request.
- C. Graphics: submit complete graphics package in the form of screen print outs for all systems specific to this project. Submittal shall reflect actual package to be utilized for installation including illustrations, points, and drop down menu lists. Identical systems can be submitted as a group under a single graphic.

- D. Equipment operation instruction and maintenance manuals: furnish four (4) hard copies and one pdf electronic copy of written instructions on the proper operation and maintenance of all equipment and apparatus furnished under this section.
- E. The FMS subcontractor shall furnish all of the foregoing to the Owner or his representative for his review as to the fulfillment of the specified requirements.

#### 1.6 TRAINING:

- A. The subcontractor shall provide competent instructors to give instructions to designated personnel in the operation and maintenance of the system as installed rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter. All training shall be held during normal working hours of 8:00 A.M. to 5:00 P.M. weekdays.
- B. Provide sixteen (16) hours of instructional training for Owner's operating personnel of up to four (4) operators per class. Training shall be provided in a minimum of four (4) sessions coordinated with the owner's schedule. Training sessions shall be scheduled at owner's convenience at any time during closeout or during the one year warranty period and shall address the following :
  - 1. Explanation of drawings, operations and maintenance manuals.
  - 2. Walk-through of the job to locate control components.
  - 3. Operator workstation and peripherals.
  - 4. DDC controller and ASC operation/function.
  - 5. Operator control functions, trends, alarm responses and data archiving.
  - 6. Remote Web based access.
  - 7. Replacing and downloading controllers.
  - 8. System troubleshooting.
- C. Contractor shall submit a training plan prior to substantial completion outlining the course material and training agenda. At a minimum, the training plan shall break identify the above listed items and provide a proposed time allocation for each of those items. Any training provided prior to this submittal shall not be considered formal training and will not be deducted from the sixteen (16) hours.
- D. Provide four (4) training manuals in binder form as part of training plan including all control sequences, controller model numbers and information, field device data, and written instructions including the following:
  - 1. Operator station log in.
  - 2. Remote web based log in.
  - 3. Scheduling.
  - 4. Temporary overrides.
  - 5. Temperature resets and adjustments.
  - 6. Controller replacement and software download.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS/INSTALLERS:

- A. The following are acceptable manufacturers:

1. Johnson Controls, Inc. as installed by local branch
2. Schneider Electric I/A as installed by local branch/partner
3. Siemens as installed by local branch
4. Alerton with Tridium software platform

## 2.2 NETWORKING COMMUNICATIONS:

- A. Inherent in the system's design shall be the ability to expand the system without the requirement of additional software or programming support.
- B. The system shall be a completely native BACnet based system. The operator workstations, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2008, BACnet.
- C. Building controller MS/TP module communications shall be through BACnet MS/TP LAN to all advanced application and application-specific controllers. MS/TP module shall also route messages to Ethernet - MS/TP module for communication over WAN. All communication with operator's workstation and all application controllers shall be through BACnet. Building controller Ethernet – MS/TP module shall incorporate as a minimum, the functions of a 2-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz) and MS/TP LAN. Ethernet – MS/TP module shall also route messages from all other building controller modules onto the BACnet Ethernet network.
- D. BACnet Conformance
  1. MS/TP module shall be approved by the BTL (BACnet Testing Laboratory) as meeting the BACnet Building Controller requirements. MS/TP module shall as a minimum support MS/TP BACnet LAN type. It shall communicate directly using this BACnet LAN as a native BACnet device and shall support simultaneous routing functions between all supported LAN types.
  2. Standard BACnet object types supported shall include, as a minimum, Analog Value, Binary Value, Calendar, Device, File, Group, Notification Class, Program, and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
  3. For all system elements—operator's workstation(s), building controller(s), application controllers, routers, and repeaters—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
  4. The system shall provide a means to scan, detect, interrogate, and edit 3rd party BACnet devices and BACnet objects within those devices.
- E. DDC panel support: DDC panels shall directly reside on an industry standard high speed communications bus (Local Area Network) such that communications may be executed directly from DDC panel to DDC panel.
- F. Access to system data shall not be restricted by the hardware configuration. The hardware configuration of the FMS network shall be totally transparent to the user. Application specific controllers shall be arranged on the bus(es) in a functional relationship manner with DDC controllers.

## 2.3 FACILITY MANAGEMENT SYSTEM HARDWARE:

- A. The Facility Management System (FMS) shall be comprised of a network of various independent Mechanical System Digital Controllers and a Centralized Head End Controller to provide centralized access and facility wide control functions. The DDC Controllers shall be interconnected in a communicating network to provide facility wide access and sharing of information.
- B. The distributed communication network system shall consist of a multi-drop RS-485 bus architecture connecting DDC Controllers. The trunk shall consist of:
  - 1. An independent hardwired network in accordance with the manufacturer's wiring practices. Run in metallic conduit where exposed below ceiling and in any location where wire is subject to physical damage.
  - 2. The network serving all controllers for new mechanical equipment shall be new. The existing communications network serving existing mechanical systems to remain can be reused to the extent possible. Provide new network where existing is incompatible with new controllers.
  - 3. There shall be no power wiring, in excess of 30 Vac rms voltage, run in conduit with communications trunk wiring. In cases where power or signal wiring is run in conduit with trunk wiring, all communications trunk wiring and power wiring shall be run using separate twisted shielded pairs (18awg) with the shields grounded in accordance with the manufacturer's wiring practices.

## 2.4 SYSTEM SOFTWARE FEATURES:

- A. General
  - 1. All necessary software to form a complete operating system, as described in this specification, shall be provided.
  - 2. Contractor shall provide owner complete data base for installed system including all sequences, proprietary software, and
  - 3. The software programs specified in this section shall be provided as an integral part of the Direct Digital Control Panels or Application Specific Controllers, and shall not be dependent upon any higher level mainframe or personal computer for execution.
  - 4. Color floor plan graphics shall be developed for operator access to the system point data, schedules, alarm management, setpoint adjustments and written sequences of operation.
- B. The FMS system shall permit an operator to create, modify and document all process control sequences including all DDC application software, energy management software, alarm processes, color graphics and links, and facilities maintenance programs provided in the DDC controllers including:
  - 1. Time of Day Scheduling
  - 2. Calendar based Scheduling
  - 3. Holiday Scheduling
  - 4. Optimal Start
  - 5. Optimal Stop
  - 6. Custom Application Programs
  - 7. Trend Logs

- C. All data including sequences, points list, graphics and any other information required to fully restore the building management system or individual components shall reside in the head end unit. The system shall be capable of downloading controller programs via the system LAN. The contractor shall also provide a back up copy of all data on an external hard drive or CD's.
- D. Provide owner with licensed copies of all software necessary to allow owner to access and program all unitary and network controllers and head end systems. This includes but is not limited to proprietary software necessary to configure and download sequences of operation. The license shall have no expiration and shall be for a minimum two (2) users.
- E. Digital Panels shall be able to execute custom application programs defined by the user to automatically perform calculations and control routines.
- F. Process Inputs and Variables: It shall be possible to use any of the following in a configured process:
  - 1. Any system-measured point data or status
  - 2. Any calculated data
  - 3. Any results from other processes
  - 4. Boolean logic operators (and, or, greater than, less than, etc.)
- G. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASCs or networked systems. In addition, a single process shall be able to issue commands to points in any and all other ASCs on the network.
- H. All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment described in Part III of this specification.
- I. The DDC panel shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
- J. The DDC panel shall provide powerfail motor restart. Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.
- K. School System Intranet Communications:
  - 1. Provide and install all Cat 6 cable, conduit, connections, hubs, etc., required to provide access via the school system intranet. DDC shall coordinate this work with the school system technology center on the proper procedures and requirements accordingly.
- L. Alarm reporting. The operator shall be able to determine the action to be taken in the event of an alarm (i.e. route alarm to the appropriate workstation, start programs, printed or display custom messages). The system shall dial out in the event of an alarm. Receivers shall include remote service PC workstations and alpha-numeric pagers. The alarm message shall include the name of the calling location, the device that generated the alarm and the alarm message itself.
- M. Scheduling.
  - 1. Operator's workstation shall show all information in easy-to-read daily format including calendar of this month and next. All schedules shall show actual ON/OFF times for day

- based on scheduling priority. Priority for scheduling shall be events, holidays and daily, with events being the highest.
2. Holiday and special event schedules shall display data in calendar format. Operator shall be able to schedule holidays and special events directly from these calendars.
  3. Operator shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
  4. System shall include a Schedule Wizard for set up of schedules. Wizard shall walk user through all steps necessary for schedule generation. Wizard shall have its own pull-down selection for startup or may be started by right-clicking on value displayed on graphic and then selecting Schedule. The user shall be capable of grouping/linking systems to master scheduling such that all systems in that group can be commanded through a single schedule. The user shall be able to add and remove systems from that group via the head end.
  5. Scheduling shall include optimum start based on outside air temperature, current heating/cooling setpoints, indoor temperature and history of previous starts. Each and every individual zone shall have optimum start time independently calculated based on all parameters listed. User shall input schedules to set time that occupied setpoint is to be attained. Optimum start feature shall calculate the startup time needed to match zone temperature to setpoint. User shall be able to set a limit for the maximum startup time allowed.
  6. Any displayed data that is changeable by the operator may be selected using the right mouse button and the schedule shall then be selectable on the screen. Selection of the schedule using this method shall allow the viewing of the assigned schedule or launch the Schedule Wizard to allow the point to be scheduled.

## 2.5 WEB BROWSER CAPABILITIES

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web Browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software resident on the client machine or manufacture-specific browsers shall not be acceptable. Provide all hardware required to host the web browser access at the site.
- B. The Web Browser client shall support at a minimum, the following functions:
  1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication techniques to prevent unauthorized access shall be implemented.
  2. Graphical screens developed for the GUI shall be the same screens used for the Web Browser client. Storage of the graphical screens shall be in the system, without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
  3. Depending on user access privileges, the user shall be able to view data, modify and command objects such as start/stop, and adjust set points. In addition, users can be provided with the ability to view logs and view and acknowledge alarms.
- C. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. The capability to limit the user to just their home page shall be provided. From the home page, links to other views, or pages in the system shall be possible.
- D. Graphic screens on the Web Browser client shall support hypertext links to other Web pages on other Internet or Intranet sites.



- E. System access shall be via a single owner provided IP address.
- F. Provide remote access set up for four (4) remote users including password protection, and customized access privileges as specified by the owner.

## 2.6 DIGITAL BUILDING LEVEL CONTROL PANEL(S):

- A. General: Digital Control Panels shall be 16 bit microprocessor-based, multi-tasking, multi-user, dedicated digital control processors. Building level control panels shall be provided for all central plant equipment and air handling units. It is acceptable to group multiple pieces of mechanical equipment on a single controller provided that the expansion capacity requirements are met.
- B. Memory: Each Digital Panel shall have sufficient memory (minimum 2 MB RAM, expandable via SIMM's) to support its own operating system and data FMS including, but not limited to:
  - 1. Custom control processes
  - 2. Energy Management Applications
  - 3. Alarm Management
  - 4. Trend Data
  - 5. Maintenance Support Applications
  - 6. Operator I/O
- C. Expandability: The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators. Each digital panel shall be installed with a 10% expansion capacity for all point types (AO, DO, DI, AI) without the addition of expansion modules.
- D. Serial Communication Ports: Digital Panels shall provide at least two RS-232C serial data communication ports for simultaneous operating of multiple operator I/O devices, such as laptop computers, Personal Computers, and alarm printers.
- E. Integrated On-line Diagnostics: Each Digital Panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. Digital Panels shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each Digital Panel.
- F. Surge and Transient Protection: Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.
- G. Powerfail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of the Digital Panel to prevent the loss of data FMS or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours. Upon restoration of normal power, the Digital Panel shall automatically resume full operation without manual intervention. Should Digital Panel memory be lost for any reason, the user shall have the capability of reloading the Digital Panel via the local RS-232C port, Operator Workstation or telephone line dial-in. Provide modem at DDC panel to allow for dial-in from remote operator workstation(s). Phone line will be provided by the OWNER.

## 2.7 APPLICATION SPECIFIC CONTROLLERS:

- A. Each standalone Digital Control Panel shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASCs). An ASC shall be provided for small unitary mechanical systems (i.e. fans, fan coil units, VAV box, etc.) Each mechanical system shall be equipped with an independent ASC.
- B. Each ASC shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-FMSed, multi-tasking, real-time digital control processor.
- C. Each ASC shall have sufficient memory to support its own operating system and data FMS including:
  - 1. Control Processes
  - 2. Energy Management Applications
  - 3. Time Programmed Start/Stop Software
- D. All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC. Any version of an ASC using RAM memory shall be provided with a battery and battery charger capable of holding all programs in memory during a power failure of seventy-two (72) hours duration. Install a label on each VAV box placed near the ASC that lists the design minimum and maximum airflows.
- E. All control outputs for air handling unit control valves and mixing dampers shall be analog type 0-10VDC or 4-20mA.
- F. Provide individual ASC for each air handling unit and air terminal device.

## 2.8 DDC FIELD DEVICES:

- A. Provide the following instrumentation as required by the monitoring, control and optimization functions:
  - 1. Temperature Sensors:
    - a. Liquid immersion temperature RTD: Temperature monitoring range 0/200 deg F, minimum, Output signal- Changing resistance, Factory calibration point+70 deg F @ 1000 deg F, Accuracy at calibration point  $\pm 0.34$  deg F.
    - b. Space/Duct temperature RTD: Temperature monitoring range 0/150 deg F minimum, Output signal - Changing resistance, Factory calibration point 70 deg F, Accuracy at calibration point  $\pm 0.34$  deg F. Duct sensors located in the mixed air and coil discharge sections shall be the averaging type with a minimum 5'-0" length.
    - c. Outside air temperature RTD: Temperature monitoring range-20/+120 deg F minimum, Factory calibration point 70 deg F @ 1000 deg F, Accuracy at calibration point  $\pm 0.34$  degrees F,
  - 2. Zone Temperature Sensor/Controller: Each VAV box temperature sensor/controller shall be capable of adjusting the temperature from the programmed set point during occupied periods. The adjustment range shall be controlled by the head end. The LCD display controller shall be capable of providing temporary override during normally unoccupied

- periods. Provide combination temperature sensor/humidity sensor where noted in points list.
3. Carbon Dioxide Sensor: ISO 9001 and 14001 certified, Non-Dispersive Infrared technology (NDIR) single channel sensor with gold or platinum plated optics. Provide automatic baseline calibration (ABC) logic providing continuous calibration. 0-2000 ppm, 3% of range accuracy. Local display not required.
  4. Differential Pressure Switch: Unit for fluid flow proof, Adjustable range from minimum differential pressure 0 dpsig, Maximum differential pressure 50 dpsig, Maximum operating pressure 325 psi.
  5. Relays: Control relays shall be dust tight with minimum DPDT contacts and shall be rated for 125% of anticipated load. Relays shall consist of relay and separable FMS with screw terminals. Relays shall be UL listed for the application.
  6. Current Sensing Relays: Current sensing relays shall be fully solid state and shall feature adjustable trip point, power LED and trip LED. Units shall be UL listed. Utilize current sensing relays for all FMS fan and pump status indication.
  7. Hydronic Pressure Transducers: Furnish and install pressure and differential pressure transducers as shown on the plans. Each unit shall be furnished with a lever operated gauge cocks and shall have snubbers installed between the gauge cocks and the transducer to eliminate pulsations. The range on the pressure transducers shall be 0-150 psig with a maximum pressure of 250 psig. The range on the differential pressure transducers shall be 0-25 dpsig with a maximum operating pressure of 250 psig. Transducers shall have a minimum accuracy of 1% of the operating range.
    - a. Transducers installed outdoors shall be encased in NEMA 3R enclosures. Transducers and static piping installed outdoors shall be charged with non-toxic antifreeze.
    - b. Acceptable Manufacturers: Triad Technologies, Veris Industries, Foxboro.
  8. Air Flow Measuring Station: Air flow stations shall utilize thermal based air measurement. The sensor accuracy shall read airflow rates within  $\pm 2\%$  of reading with  $\pm 2\%$  repeatability and temperature within  $\pm 0.15$  deg F. Ebtron Gold series or approved equal.
  9. Air pressure transducers: Furnish and install air pressure and differential pressure transducers as shown on the plans. The range on the pressure transducers shall be 0-2 inwg for filter differential pressure measurement and 0-4 inwg for supply duct static pressure sensors with a maximum pressure of 10 inwg. Transducers shall have a minimum accuracy of 5% of the operating range. Filter differential pressure transducers shall include a local digital display.
  10. Insertion Flow Meters: Dual-turbine, insertion type flow meter. Coordinate installation location in field to maintain manufacturer recommended upstream and downstream straight pipe requirements. Onicon model F-12, or equal.
  11. Dewpoint Monitors: Silicon based polymer capacitance principle sensor, dewpoint range of 5-185 deg F with  $\pm 2\%$  dew point accuracy, 4-20mA output and local dew point temperature display. Provide wall mount kit and weatherproof/breathable enclosure. GE DewPro MMR31 or equal.

## 2.9 TEMPERATURE CONTROL EQUIPMENT:

### A. Control Dampers

1. Automatic control and smoke dampers shall be of sizes as indicated on Plans. Damper frames shall not be less than 13 gauge galvanized steel formed for extra strength with mounting holes for flange and enclosed duct mounting.
2. Return Air Applications - All damper blades shall not be less than 16 gauge galvanized steel roll formed for high velocity performance. Blades on all dampers shall be 6" wide or

less. Blade bearings shall be nylon standard with ½" zinc plated steel shafts. All blade linkage hardware shall be of corrosion-resistant finish and readily accessible for maintenance after installation. Neoprene reinforced blade edge seals and spring loaded stainless steel side seals shall be provided to insure leakage of not more than 1% at 1500 fpm approach velocity at 4" static closing to torque. Dampers and seals shall be suitable for temperature ranges of -40 to 200 degrees F.

3. Outside Air Applications – Extruded aluminum opposed blade construction with stainless steel axles, linkages, and bearings. Dampers shall be rated at 6 INWG, 6,000 FPM with maximum leakage of 6 CFM/sqft at 4 INWG.
4. Dampers shall be minimum leakage type for all applications. Temperature control contractor shall submit leakage and flow characteristics for all control dampers. Dampers shall be rated for dynamic conditions.

B. Damper Actuators

1. Units shall be electronic and shall be smooth and quiet in operation. If specified in the sequence of operation in the event of power failure, actuators shall be provided with spring return so that they will "fail safe" in either normally open or normally closed position. Size all actuators to operate control items to which they are connected with 50% spare capacity. Actuators shall be housed in NEMA 3R enclosures and shall be listed under UL 916 and UL 873. Actuators mounted outdoors shall have a NEMA 4X enclosure.

C. Low Limit Thermostats

1. Low limit thermostats shall be manual reset type with bellows actuated switch. The sensing element shall have a minimum length of 20 feet and shall be such that if any point on the element senses the set point it will react.

D. High Limit Thermostats (Firestats)

1. Safety high limit thermostats shall be furnished and installed where shown. High limits shall be interlocked to stop fan when temperature in excess of 125°F is sensed.

E. Control Valves

1. Automatic control valves shall be of the 2-way,modulating type and shall be constructed of bronze for valve sizes two inches and smaller and cast iron for valve sizes larger than two inches. All control valves shall be protected by a Y-strainer
2. Automatic valves up to two and one-half inch size shall have screwed globe bodies, valves larger than two and one-half inch shall have flanged bodies. All valves shall have bronze trim, stainless steel stems with self-adjusting Teflon packing.
3. Water valves shall be sized with a 3.5 psig maximum allowable pressure drop at design flow unless otherwise indicated.
4. Automatic control valves shall be fully proportioning with modulating plug, V-port inner valves, or characterized ball valves unless noted otherwise.
5. Valves shall be quiet in operation and fail-safe with spring return to the normally closed position in the event of failure. For the VAV boxes, valves shall be non-spring return, 0-10V proportional type. All valves shall be capable of operating in sequence when required by the sequence of operation.

6. All control valves shall be sized by the control manufacturer to meet the cooling or heating loads as scheduled. All control valves shall be suitable for the pressure conditions and close against the differential pressure involved.
7. Water valves, throttling type and bypass valves shall have linear flow characteristics. Valves shall be single seated type, except where pressure and flow combination exceeds rating for commercial valve operators, double seated valves may be used.
8. Normally closed valves shall be overridden open during system fill and purge to allow proper air purge.

F. POWER MONITOR

1. Provide and install one (1) power / phase monitor, connected to protect all new controlled loads / equipment against the following conditions:
  2. Phase Loss, Phase Reversal, Phase Imbalance
  3. High Voltage
  4. Low Voltage
  5. Locate power monitor in the addition electrical room. Provide a 16 gauge, hinged door enclosure with perf panel.

G. ENCLOSURES

1. All enclosures shall include a hinged door with a latch and back plate perf panel.
2. NEMA 1 enclosures shall be painted 16 gauge steel construction.
3. NEMA 4 enclosures shall be powder coated, 16 gauge galvanized steel construction with seamless sides and door gasketing.

H. TIMED OVERRIDE BUTTONS

1. All A/C, heating and lighting controls shall include a means of after normal hour operation activation. Push buttons with schedule status LED's, twist timers, etc. shall be installed depending on the application to provide a timed override function. The timed override duration shall be adjustable up to four (4) hours.
2. Overrides for the Administration shall be located at the thermostat. Overrides for classroom wings may be located in the administration area or in an easily accessible area within the wing.
3. Overrides in high traffic areas shall include a protective guard.

I. SENSOR COVERS

1. Provide heavy-duty metal non-accessible cast aluminum sensor or thermostat covers for all located in high traffic areas.

J. CONDENSATE PAN SAFETY (FLOAT) SWITCH

1. Provide and install one (1) condensate pan float switch in all system applications where condensate emergency pans are installed. Interlock float switch in the safety circuit to stop all unit operation upon detection of water.

2.10 RELAYS

- A. Control relays shall be dust tight with minimum DPDT contacts and shall be rated for 125% of anticipated load. Relays shall consist of relay and separable DDC with screw terminals. Relays shall be UL listed for the application.

2.11 CURRENT SENSING RELAYS:

- A. Current sensing relays shall be fully solid state and shall feature adjustable trip point, power LED and trip LED. Units shall be UL listed. Utilize current sensing relays for all DDC fan and pump status indication.

2.12 FIELD INSTALLED AIR FLOW MEASURING STATIONS

- A. Air flow stations shall utilize thermal based air measurement. The sensor accuracy shall read airflow rates within  $\pm 2\%$  of reading with  $\pm 2\%$  repeatability and temperature within  $\pm 0.15$  deg F. Ebtron Gold series or approved equal.

2.13 PASSIVE INFRARED MOTION SENSORS

- A. Passive infrared (PIR) motion sensors shall be low voltage contact type sensors with no manual switching capability.
- B. The sensors shall be wall mounted in a location near the entry door into the room to detect motion entering and leaving the space. It is not critical that the motion sensor be able to detect motion within the subdivided spaces within the room.
- C. The sensor and cover plate shall match the color of the light switches in the room.

2.14 CONTROL WIRING

- A. All wiring required for the control system, including the BLNM, Field Control Modules, relays, control transformer panels, firestats, exhaust fans and all interlocking, shall be furnished and installed by the Temperature Controls Contractor.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. All control (low voltage) wiring located outdoors shall be in E.M.T. or PVC conduit.
- D. All control wiring located indoors where an accessible ceiling is not available shall be installed in E.M.T. conduit.
- E. All power wiring and conduit shall be by Division 16 and coordinated by the DDC.
- F. All control wiring located above accessible ceilings shall be N.E.C. cable. All control wiring located above accessible ceilings used as air plenums shall be N.E.C. approved "Plenum cable".
- G. All conductors shall be copper. Conductors used for control circuits shall be #16 or #18, stranded. Conductors used for sensor circuits shall be #18, shielded, twisted.

## 2.15 NAMETAGS

- A. All temperature control devices, panels, and equipment, etc., shall be labeled with a face engraved nametag. Locate tag on each device to identify the device function as referenced in the control drawings.

## 2.16 CONTROL DRAWINGS

- A. Provide six (6) sets of preliminary shop drawings in AutoCAD format with specifications on all devices to be included in the system for approval by the engineer.
- B. Drawings shall indicate point-to-point, wire-for-wire detail to indicate all aspects of the system. Include site plans indication intended cable runs and proposed zoning, all bound in a three ring binder.
- C. Provide six (6) copies of as-built AutoCAD drawings, installation instructions and operation instructions at the end of the job all bound in a three ring binder.

## 2.17 JOB SITE COMPUTER SOFTWARE

- A. The customer will utilize the existing desktop computers, on the job site or remote, for use by the administrative and maintenance staff.
- B. The contractor shall configure up to (4) owner selected computers for local or remote web-based access.

## PART 3 - HVAC EQUIPMENT CONTROL SEQUENCES

### 3.1 SEQUENCES OF OPERATION AND POINTS LIST

- A. This summary is provided to establish a minimum guide for DDC configuration. The DDC subcontractor shall be required to provide and install any additional points required to meet the DDC system and Sequences of Operation specified herein. The contractor shall provide all supplemental control devices and sequences recommended by the manufacturer for all equipment controlled by the DDC.
- B. The sequences of operation and points list shall be provided according to the following unless noted otherwise. Refer to drawings for counts of items listed as "Varies."
- C. Common Sequences. All HVAC systems shall be equipped with the following control and sequencing:
  - 1. Alarms shall be provided for all set points with an adjustable alarm set point differential (both high and low), alarm delay, alarm disable switch, and alarm priority. Alarms shall be provided for all enable/disable commands with status sensors to alarm when those conditions do not match.
  - 2. Optimal Start/Stop Control: All equipment shall include an optimal start stop sequence. Equipment necessary for the operation of other equipment shall be interlocked such that

- a single priority enables all necessary equipment for that system. Refer to Section 230923 for additional requirements.
3. Scheduling: All equipment shall be capable of group and individual scheduling. Equipment necessary for the operation of other equipment shall be interlocked such that a single scheduling command enables/disables all necessary equipment for that system. Refer to section 23 09 23 for additional requirements.
- D. The listed sequences of operation are for comfort control only and do not list required safety controls. All required safety controls, including but not limited to, smoke detectors, firestats, smoke dampers and fire alarm interlock shall be installed in accordance to NFPA 96 and applicable codes.
1. AHU fans shall be disabled by the fire alarm smoke detectors via hard wired interlock. Control contractor shall provide wiring from fire alarm relay. Coordinate relay location with fire alarm vendor.
- E. Refer to the equipment specifications including, but not limited to, variable refrigerant volume air conditioning, variable frequency controllers, dedicated outdoor-air units, and fire alarm for required integration to factory mounted panels.
- F. System Control Summary – Mini-split and D/X Split Heat Pump Systems
1. Description: Individual mini-split and D/X split heat pump systems with dedicated outdoor units.  
  
 Sequence of Operation: DDC control shall be limited to start/stop control, space temperature set point control, space temperature monitoring and alarm status monitoring for indoor and outdoor equipment through BACnet interface with heat pump master controller. All equipment control shall be provided by factory mounted controls as specified with the mini-split and D/X split equipment section. Refer to Split System Heat Pump specification 238126 for BACnet interface and system integration. Points required may be monitored via a direct communication link with the BACnet compatible system interface. Units shall be integrated into optimal start up sequence with priority setting (adjustable).
  2. Smoke Detector Control: Where smoked detectors are shown on the floor plans, fans shall be disabled by the fire alarm smoke detectors via hard wired interlock. Controls contractor shall provide wiring from fire alarm relay. Coordinate relay location with fire alarm vendor.
  3. Points List To DDC System for heat pump systems:

Quantity	Description	Type	Field Device
1/unit	Enable/Disable	BO	BACnet
1/unit	Zone Temperature Sensor	AI	BACnet
1/unit	Zone Temp Set Point	AI	BACnet
1/unit	Indoor Unit Alarm	BI	BACnet
1/unit	Outdoor Unit Alarm	BI	BACnet

4. Notes:
  - a. All set points shall be adjustable.



G. System Control Summary - 100% Outside Air Unit, Constant Air Volume, Electric Heating, D/X Cooling, Hot Gas Reheat.

Description: Constant Air Volume, VFD fan for balancing, electric heating (re-heat position), D/X cooling, hot gas reheat, and 100% outside air. The fully conditioned outdoor air shall be supplied to local ceiling diffusers and or directly to spaces through diffusers.

1. Sequence of Operation: DDC control shall include start/stop control, discharge air temp and humidity monitoring, filter differential pressure and alarm status monitoring through BACnet interface with DOAS controller. Direct DDC points and field devices shall include discharge air temperature, discharge air humidity and outside air unit discharge dewpoint alarm. Unit shall be enabled by schedule only and shall not be enabled by temporary occupancy override. Provide high dewpoint alarm and disable DOAS unit if discharge air dewpoint exceeds 60 deg F (adjustable). Provide filter differential pressure monitors with alarm notification when pressures exceed loaded filter set points (adjustable).
2. Smoke Detector Control: AHU fans shall be disabled by the fire alarm smoke detectors via hard wired interlock. Controls contractor shall provide wiring from fire alarm relay. Coordinate relay location with fire alarm vendor.

3. Points List To DDC System for DOAS unit:

Quantity	Description	Type	Field Device
1	Enable/Disable	BO	BACnet
1	Discharge Air Temp	AI/AO	BACnet
1	Discharge Air Humidity	AI	BACnet
1	Entering Air Temp	AI	BACnet
1	Alarm Status	BI	BACnet
1	Filter Differential Pressure	AI/BO	BACnet
1	Discharge Air Dewpoint	AI	RTD/%RH Sensors
1	Discharge Air Dewpoint Set Pt	AO	Virtual
1	Dewpoint Alarm	BI	Virtual
1	Entering Air Dew Point	AI	BACnet

4. Notes:
  - a. All set points shall be adjustable.

H. System Control Summary – Heating/Cooling, Constant Air Volume, D/X Heat Pump, Packaged Rooftop Units.

1. Description: Constant air volume, VFD fan for balancing, D/X cooling, heat pump with supplemental electric heat, demand controlled ventilation. Encompasses RTU-1, 3, 5 & 6.
2. Sequence of Operation RTU-1, 5 & 6: Stages of cooling/heating shall be controlled by RTU factory controller with BACnet interface. Stages of cooling, heat pump and supplemental electric shall engage as required to maintain space temperature.
3. Sequence of Operation RTU-3: Same as above but with outside air demand controlled via CO2 sensor and damper.
4. Smoke Detector Control: RTU fans shall be disabled by the fire alarm smoke detectors via hard wired interlock. Controls contractor shall provide wiring from fire alarm relay. Coordinate relay location with fire alarm vendor.
5. Points List To DDC System for RTU-1, 3, 5 & 6:

Quantity	Description	Type	Field Device	RTU
1	Enable/Disable	BO	BACnet	1, 3, 5, 6
1	Space Temp	AI/AO	BACnet	1, 3, 5, 6
1	Status	BI	BACnet	1, 3, 5, 6
1	Entering Air Temp	AI	BACnet	3
1	Outside Air Damper Position	AI/BO	BACnet	3
1	Return Air Damper Position	AI/BO	BACnet	3
1	Filter Differential Pressure	AI/BI	BACnet	1, 3, 5, 6
1	Discharge Air Dewpoint	AI	RTD/%RH Sensors	3
1	Discharge Air Dewpoint Set Pt	AO	Virtual	3
1	Entering Air Dew Point	AI	BACnet	3
1	CO2 PPM	AI	BACnet	3
1	CO2 PPM Set Pt	AO	BACnet	3

6. Notes:
  - a. All set points shall be adjustable.
  - b. Return air sensors shall be duct mounted in largest return duct. Plenum mounted sensors shall be within the return air ductwork.
  - c. A common sensor for outside air conditions is acceptable for all HVAC systems. Controls shall be configured to default to normal operation if outside air data becomes unreliable.
  - d. Contractor shall provide quantities of each point according to units indicated. Verify quantities before ordering.

I. System Control Summary - Heating/Cooling, Constant Air Volume, D/X, Electric Heat, Hot Gas Reheat, Packaged Rooftop Units.

1. Description: Constant air volume, VFD fan for balancing, D/X cooling, heat pump with supplemental electric heat, demand controlled ventilation. Encompasses RTU-2 & 4.
2. Sequence of Operation RTU-2 & 4: Stages of cooling/heating shall be controlled by RTU factory controller with BACnet interface. Stages of cooling, electric heat and hot gas reheat shall engage as required to maintain space temperature. Outside air demand controlled via CO2 sensor and damper.
3. Smoke Detector Control: RTU fans shall be disabled by the fire alarm smoke detectors via hard wired interlock. Controls contractor shall provide wiring from fire alarm relay. Coordinate relay location with fire alarm vendor.

4. Points List To DDC System for RTU-2 & 4:

Quantity	Description	Type	Field Device
1	Enable/Disable	BO	BACnet
1	Discharge Air Temp	AI/AO	BACnet
1	Discharge Air Humidity	AI	BACnet
1	Entering Air Temp	AI	BACnet
1	Alarm Status	BI	BACnet
1	Filter Differential Pressure	AI/BO	BACnet
1	Discharge Air Dewpoint	AI	RTD/%RH Sensors
1	Discharge Air Dewpoint Set Pt	AO	Virtual
1	Dewpoint Alarm	BI	Virtual
1	Entering Air Dew Point	AI	BACnet
1	CO2 PPM	AI	BACnet
1	CO2 PPM Set Pt	AO	BACnet
1	Space Temp Sensor	AI/AO	BACnet

5. Notes:

- a. All set points shall be adjustable.
- b. Return air sensors shall be duct mounted in largest return duct. Plenum mounted sensors shall be within the return air ductwork.
- c. A common sensor for outside air conditions is acceptable for all HVAC systems. Controls shall be configured to default to normal operation if outside air data becomes unreliable.
- d. Contractor shall provide quantities of each point according to units indicated, RTU-2 & 4. Verify quantities before ordering.

J. System Control Summary – Exhaust Fan, Continuous Operating

- a. Continuous Operating, EF-1, 2, 5, 6, 7, 8
- b. Switch Controlled, EF-3, 4, 10, 11, 12, 14
- c. Thermostat Controlled, EF-9 & 13

1. Description: Fixed speed exhaust fans.

2. Fan Control: Fans shall be controlled individually with start/stop either via schedule unless noted as local control on plans. Motorized dampers and other associated equipment shall be interlocked to the start/stop point. Status shall be monitored on all fans. Exhaust fans not interlocked with other equipment shall be linked to common enable/disable point to allow user to disable multiple exhaust fans via single point. Temperature controlled fans shall be enabled/disabled based on space temperature set point (adjustable). All fans shall be monitored via current sensing relays to display fan status. Generate an alarm when start/stop and status conflict. Fans controlled with local line voltage thermostats do not require connection to DDC system.

3. Continuous Operating Fans Control: Fans shall be interlocked to DOAS-1 such that DOAS-1 shall be operational when fans are active.

4. Point List:

Quantity	Description	Type	Field Device	Unit
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1	Start/stop	BO	Relay	All
1	Status	BI	Current sensing relay	All
1	Space Temp	AI/AO	BACnet	9, 13

5. Notes:
  - a. Contractor shall provide quantities of each point indicated. Verify quantities before ordering.

## PART 4 - EXECUTION

### 4.1 GENERAL REQUIREMENTS

- A. Electrical work shall include furnishing and installing conduit and wire, mounting electric/electronic system components, and final connections at pneumatic-electric control system components, contactors, motor starters and numbered terminals on packaged air conditioning units, and electric heating coils. Connection to the control power circuits shall be work of this division.
- B. The wiring of the temperature controls and interlocks shall be in strict accordance with all governing codes and with the requirements of Division 26. All control wiring exposed in equipment rooms, outdoors or located where mechanical damage to the wire could occur shall be run in conduit. Conduit shall be as specified in the electrical section of these Specifications. All indication wire shall be No. 18 minimum size and all interlock wire shall be No. 12 minimum size. All wire shall have type THHN insulation. Wiring within the ceiling space shall be plenum rated.

- C. Maximum voltage for the temperature control and interlock wiring shall be 120V. All starters shall be supplied with 120V holding coils, integral control transformers, hand-off-automatic switches and two extra auxiliary contacts.
- D. The electrical contractor shall provide all power wiring to the starters and from the starters to the motors.
- E. Thermostats or sensors mounted on outside walls shall be mounted on 1" minimum thickness rigid fiberglass (or equal) insulating bases with solar guards. Thermostats or sensors with set point adjustments shall be mounted in compliance with ADA requirements.
- F. All temperature sensors located in water lines shall be installed in separable wells packed with heat conductive compound. All temperature sensors installed in ductwork shall penetrate the duct by at least six inches.
- G. All temperature controls located outdoors or in wet locations (i.e. mechanical rooms containing steam systems) shall be installed in NEMA 4X enclosures including controllers and operators.

#### 4.2 BAS START-UP TESTING, ADJUSTING, CALIBRATION

- A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:
  - 1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance with them.
  - 2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
  - 3. Verify integrity/safety of all electrical connections
  - 4. Coordinate with TAB subcontractor to obtain and fine-tune control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the BAS Start-Up Report:
    - a. Optimum duct static pressure setpoints for VAV air handling units.
    - b. Minimum outside air damper settings for air handling units
    - c. Optimum differential pressure setpoints for variable speed pumping systems.
    - d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
  - 5. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the BAS Test Report.
  - 6. Check and set zero and span adjustments for all transducers and transmitters.
  - 7. For dampers and valves:
    - a. Check for adequate installation including free travel throughout range and adequate seal.
    - b. Where loops are sequenced, check for proper control without overlap.
    - c. For all activities record results of testing conducted in BAS Test Report.
  - 8. For actuators:
    - a. Check to insure that device seals tightly when the appropriate signal is applied to the operator per leak check procedures.
    - b. Check for appropriate fail position, and that the stroke and range is as required.

- c. For pneumatic operators, adjust the operator spring compression as required to achieve close-off. If positioner or volume booster is installed on the operator, calibrate per manufacturer's procedure to achieve spring range indicated. Check split-range positioners to verify proper operation. Record settings for each device in the BAS Test Report
- d. For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.
- e. For all activities record results of testing conducted in BAS Test Report.
9. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the Operator Interface display. Record the results for each device in the BAS Test Report.
10. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
11. Verify proper sequences by using the approved functional test procedures to record results and submit with BAS Test Report. Verify proper sequence and operation of all specified functions.
12. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
13. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the BAS Test Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond) in the control loop, tolerances shall be maintained (exceptions noted):
  - a. Duct air temperature:  $\pm 1 \square F$ .
  - b. Space Temperature:  $\pm 2 \square F$
  - c. Chilled Water:  $\pm 1 \square F$
  - d. Hot water temperature:  $\pm 3 \square F$ .
  - e. Duct pressure:  $\pm 0.25$ " w.g
  - f. Water pressure:  $\pm 1$  psid
  - g. Duct or space Humidity:  $\pm 5\%$
  - h. Air flow control:  $\pm 5\%$  of setpoint velocity.
  - i. Space Pressurization (on active control systems):  $\pm 0.05$ " wg with no door or window movements.
14. For interface and DDC control panels:
  - a. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
  - b. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
  - c. Check power supplies for proper voltage ranges and loading.
  - d. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
  - e. Check for adequate signal strength on communication networks.
  - f. Check for standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
  - g. Ensure that all outputs and devices fail to their proper positions/states.
  - h. Ensure that buffered and/or volatile information is held through power outage.
  - i. With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
  - j. Check for adequate grounding of all DDC panels and devices.

15. For Operator Interfaces:
    - a. Verify that all elements on the graphics are functional and are properly bound to physical devices and/or virtual points, and that hot links or page jumps are functional and logical.
    - b. Output all specified BAS reports for review and approval.
    - c. Verify that the alarm printing and logging is functional and per requirements.
    - d. Verify that trends are archiving to disk and provide a sample to the CxA for review.
    - e. Verify that paging/dial-out alarm annunciation is functional.
    - f. Verify the functionality of remote Operator Interfaces and that a robust connection can be established consistently.
    - g. Verify that required third party software applications required with the bid are installed and are functional.
  16. Start-up and check out control air compressors, air drying, and filtering systems in accordance with the appropriate section and with manufacturer's instructions.
  17. Verify proper interface with fire alarm system.
- B. Submit BAS Test Report: Report shall be completed, submitted, and approved prior to Demonstration testing.

#### 4.3 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that all sensor locations are appropriate and are away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading of each other for pressure. Tolerances for critical applications may be tighter.
- B. Calibration: Calibrate all sensors using one of the following procedures:
1. Sensors Without Transmitters - Standard Application: Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
  2. Sensors With Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or BAS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.
- C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device. Refer to Section 15951.

#### 4.4 COIL VALVE LEAK CHECK

- A. Verify proper close-off of the valves. Ensure the valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the Operator Interface, command the valve to close. Energize fans. After 5 minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat, or replacing the valve as applicable.

#### 4.5 VALVE STROKE SETUP AND CHECK

- A. For all valve and actuator positions checked, verify the actual position against the Operator Interface readout.
- B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed, and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command the valve to various few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator.

END OF SECTION



## SECTION 231123-FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

#### 1.2 PERFORMANCE REQUIREMENTS

##### A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

##### B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 3 psig.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data: For each type of product indicated.

##### B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

#### 1.4 INFORMATIONAL SUBMITTALS

##### A. Welding certificates.

##### B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

##### A. Operation and maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Gas rated threaded or mega-press fittings are acceptable.
  - 5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
    - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

### 2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  - 4. Operating-Pressure Rating: 0.5 psig.
  - 5. End Fittings: Zinc-coated steel.
  - 6. Threaded Ends: Comply with ASME B1.20.1.
  - 7. Maximum Length: 72 inches.
- B. Y-Pattern Strainers:
  - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for NPS 2 and smaller.
  - 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  - 4. CWP Rating: 125 psig.

- C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Perfection Corporation; a subsidiary of American Meter Company.
  - 2. Body: Bronze, complying with ASTM B 584.
  - 3. Ball: Chrome-plated bronze.
  - 4. Stem: Bronze; blowout proof.
  - 5. Seats: Reinforced TFE; blowout proof.
  - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 8. CWP Rating: 600 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## 2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Eclipse Combustion, Inc.
  - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - e. Invensys.
  - f. Maxitrol Company.
  - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. Canadian Meter Company Inc.
  - b. Eaton Corporation; Controls Div.
  - c. Harper Wyman Co.
  - d. Maxitrol Company.
  - e. SCP, Inc.
3. Body and Diaphragm Case: Die-cast aluminum.
4. Springs: Zinc-plated steel; interchangeable.
5. Diaphragm Plate: Zinc-plated steel.
6. Seat Disc: Nitrile rubber.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
9. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
10. Maximum Inlet Pressure: 5 psig

## 2.6 DIELECTRIC UNIONS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. Jomar International Ltd.
  - e. Matco-Norca, Inc.
  - f. McDonald, A. Y. Mfg. Co.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- h. Wilkins; a Zurn company.
- 2. Description:
  - a. Standard: ASSE 1079.
  - b. Pressure Rating: 125 psig minimum at 180 deg F.
  - c. End Connections: Solder-joint copper alloy and threaded ferrous.

### PART 3 - EXECUTION

#### 3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Aboveground piping shall be steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
- C. Steel Piping with Protective Coating:
  - 1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
  - 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  - 3. Replace pipe having damaged PE coating with new pipe.
- D. Install fittings for changes in direction and branch connections.
- E. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

#### 3.2 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Piping serving systems over .5 psig shall be welded schedule 40 steel.
- C. Piping serving systems under .5 psig shall be threaded or welded schedule 40 steel.
- D. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- E. Arrange pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- F. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- I. Locate valves for easy access.
- J. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- S. Connect branch piping from top or side of horizontal piping.
- T. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment.
- U. Do not use natural-gas piping as grounding electrode.
- V. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- W. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."
- X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."

- Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 23 Section "Sleeves and Sleeve Seals for HVAC Piping."
- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Section "Escutcheons for HVAC Piping."

### 3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### 3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
  - 6. Threaded joints shall be rated for pipe service pressure.
- D. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.
  - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.



### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  - 2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  - 3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

### 3.6 CONNECTIONS

- A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- B. Install piping adjacent to appliances to allow service and maintenance of appliances.
- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54, the International Fuel Gas Code, and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  
- C. Valves in branch piping for single appliance shall be one of the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.

END OF SECTION

## SECTION 232300 - REFRIGERANT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.
- B. The "Manufacturer" as used herein in this Specification Section shall mean the Manufacturer of the air cooled condensing units, chillers with remote air cooled condensers, other Direct Expansion (D/X) refrigeration equipment, etc. requiring field fabricated and installed refrigerant piping and associated specialties.

#### 1.2 SUBMITTALS

- A. Product Data: Submit calculations and layout drawings of each complete refrigerant piping installation including, but not limited to, size, pressure drop, layout, and location of the following: Piping, valves, filters, dryers, site glasses, etc. as required by the Manufacturer.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment. Shop drawings shall be submitted for manufacturer approval prior to submittal to the architect.
  - 1. Refrigerant piping indicated is schematic only. Size piping and design the actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and compliance with warranties of connected equipment.
- C. Welding and brazing certificates
- D. Field quality-control test reports.
- E. Operation and maintenance data.

#### 1.3 QUALITY ASSURANCE

- A. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- B. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."
- C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

### PART 2 - PRODUCTS

## 2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B 280, Type ACR .
- B. Annealed-Temper Copper Tube: ASTM B 280, Type ACR .
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Wrought-Copper Unions: ASME B16.22.
- E. Bronze Filler Metals: AWS A5.8, Classification BAg-1 (silver)

## 2.2 VALVES

- A. Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature; globe design with straight-through or angle pattern; forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, and with solder-end connections.
- B. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature; forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, and with solder-end connections.
- C. Service Valves: 500-psig pressure rating; forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, and with solder-end connections.
- D. Thermostatic Expansion Valves: Comply with ARI 750; brass body with stainless-steel parts; thermostatic-adjustable, modulating type; size and operating characteristics as recommended by manufacturer, and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.
- E. Hot-Gas Bypass Valve: Pulsating-dampening design, stainless-steel bellows and polytetrafluoroethylene valve seat; adjustable; sized for capacity equal to last step of compressor unloading; with solder-end connections.
- F. 4-way Reversing Valve: slide valve with soldered connections.

## 2.3 REFRIGERANT PIPING SPECIALITIES

- A. Straight- or Angle-Type Strainers: 500-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen of 80 to 100 mesh in liquid lines up to 1-1/8 inches (30 mm), 60 mesh in larger liquid lines, and 40 mesh in suction lines; with screwed cleanout plug and solder-end connections.
- B. Moisture/Liquid Indicators: 500-psig maximum working pressure and 200 deg F (93 deg C) operating temperature; all-brass body with replaceable, polished, optical viewing window with color-coded moisture indicator; with solder-end connections.

- C. Replaceable-Core Filter-Dryers: 350-psig maximum working pressure; heavy gage protected with corrosion-resistant-painted steel shell, flanged ring and spring, ductile-iron cover plate with steel cap screws; wrought-copper fittings for solder-end connections; with replaceable-core kit, including gaskets and the following:
  - 1. Filter-Dryer Cartridge: Pleated media with solid-core sieve with activated alumina, ARI 730 rated for capacity.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Type ACR drawn-copper tubing or soft annealed line sets.

#### 3.2 VALVE APPLICATIONS

- A. Valve applications are subject to approval for use by the Manufacturer. Valves shall be applied as specified unless the manufacturer does not approve of the application.
- B. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor, for gage taps at hot-gas bypass regulators, on each side of strainers.
- C. Install packed-angle valve in liquid line between receiver shutoff valve and thermostatic expansion valve for system charging.
- D. Install diaphragm packless or packed-angle valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.
- E. Install thermostatic expansion valves as close as possible to evaporator.
  - 1. If refrigerant distributors are used, install them directly on expansion-valve outlet.
  - 2. Install valve so diaphragm case is warmer than bulb.
  - 3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line. Locate bulb as recommended by the manufacturer.
  - 4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- F. Install pressure-regulating and pressure relief valves as required by ASHRAE 15. Pipe pressure relief valve discharge to outside.
- G. Install reversing valves in heat pump applications.

#### 3.3 SPECIALTY APPLICATIONS

- A. Install liquid indicators as recommended by manufacturer. .

- B. Install strainers as recommended by manufacturer.
- C. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.
- D. Install pressure relief valves on ASME receivers; pipe discharge to outdoors.
- E. Install filter/dryers and suction line filters as required by the Manufacturer. Fabricate the piping at all filter/dryers and suction line filter so that the core can be removed horizontally or down.
- F. Install solenoid valves as recommended by manufacturer.
- G. Install receivers, sized to accommodate pump-down charge, on systems with long piping runs as recommended by manufacturer.
- H. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

### 3.4 PIPING INSTALLATION

- A. Install refrigerant piping according to ASHRAE 15.
- B. Basic piping installation requirements are specified in Division 23 Section "Basic Mechanical Materials and Methods."
- C. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- D. Arrange piping to allow inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.
- E. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- F. Belowground, install copper tubing in protective conduit. Vent conduit outdoors.
- G. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.
- H. Slope refrigerant piping as follows:
  - 1. Pitch all horizontal refrigerant lines ½" per 10' in the direction of refrigerant flow.
  - 2. Install the suction line so that it drops below the evaporator coil before any horizontal run.
  - 3. If the the A/C System(s) have paired condensing units serving single AHU's with Intertwined coils, expansion valves at the evaporator coils may have to be field changed or modified. Follow Manufacturer's requirements.

4. Install traps and double risers to entrain oil in vertical runs.
- I. Install unions to allow removal of solenoid valves, pressure-regulating valves, and expansion valves and at connections to compressors and evaporators.
- J. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.
- K. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports."
- L. Install the following pipe attachments:
  1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6.0 m) long.
  2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6.0 m) or longer.
  3. Pipe rollers for multiple horizontal runs 20 feet (6.0 m) or longer, supported by a trapeze.
  4. Spring hangers to support vertical runs.
- M. Install hangers with the following maximum spacing and minimum rod sizes:
  1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch .
  2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
  3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
  4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- N. Support vertical runs at each floor.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Braze joints according to Division 23 Section "Basic Mechanical Materials and Methods."
- B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent scale formation.

### 3.6 REFRIGERANT PIPE INSULATION

- A. Insulate all suction lines as specified in Division 23 07 19 "Pipe Insulation".
- B. Do not insulate the liquid lines on straight cooling units, except where they come in Contact with the suction lines. Insulate all liquid lines on all heat pumps.
- C. Do not apply the insulation until the refrigerant piping system has passed all tests and inspections as specified herein, but not limited to, pressure testing and the Manufacturer inspection.

### 3.7 FIELD QUALITY CONTROL

- A. Test and inspect refrigerant piping according to ASME B31.5, Chapter VI.
1. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure.
  2. Test high- and low-pressure side piping of each system at not less than the lower of the design pressure or the setting of pressure relief device protecting high and low side of system.
    - a. System shall maintain test pressure at the manifold gage throughout duration of test.
    - b. Test joints and fittings by brushing a small amount of soap and glycerine solution over joint.
    - c. Fill system with nitrogen to raise a test pressure of 150 psig or higher as required by authorities having jurisdiction.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.
- B. The contractor shall not startup the equipment served by the refrigerant piping system until given written approval by the Manufacturer with copies to the Architect/Engineer that the installed refrigerant piping system meets their standards and adheres to the submitted shop drawings.

### 3.8 SYSTEM CHARGING

- A. Charge system using the following procedures:
1. Install core in filter-dryer after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to a vacuum of 500 micrometers (67 kPa). If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
  4. Charge system with a new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION



## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg.
- B. See Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal ducts.
  - 1. Penetrations through fire-rated and other partitions.
  - 2. Duct accessories, including access doors and panels.
  - 3. List bottom of duct elevations for coordination with other trades.

#### 1.3 QUALITY ASSURANCE

- A. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

### 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, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

#### 2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.3 SEALANT MATERIALS

- A. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
  - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

## 2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Lockformer.
  - 2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
  - 3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

## 2.6 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Ducts serving as clothes dryer exhaust shall be constructed of minimum 26 gauge galvanized steel with snap-seam longitudinal seams for smooth interior finish.

## 2.7 DOUBLE WALL SPIRAL DUCT (ROUND AND FLAT-OVAL)

- A. Duct shall be double wall, galvanized spiral lock seam with 2" fiberglass insulation, and a perforated galvanized steel liner.
- B. Exterior duct shall be paintable galvanized duct. Interior liner shall be perforated galvanized sheet metal.
- C. Insulation shall be 2" thick, fiberglass insulation with a high density acrylic coating to prevent erosion and an antimicrobial agent. Duct shall have an insulation value of R7 or higher.
- D. Fittings shall be standing seam type with 2" thick insulation and solid wall liner.
- E. Ducts shall be suspended by threaded rods connected on opposing sides of slip flange. Flanges shall be spaced as recommended by manufacturer.

- F. Duct and supports shall be painted to match surrounding steel. Refer to architectural finishes for color.

2.8

### PART 3 - EXECUTION

#### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
  1. Medium Pressure Supply Ducts (Upstream of Air Terminal Units): 3-inch wg, round ducts shall be lock seam spiral round.
  2. Low Pressure Supply Ducts (Downstream of Air Terminal Units and constant volume RTU's): 1-inch wg, round duct shall be longitudinal seam duct.
  3. Return Ducts (Negative Pressure): 2-inch wg, round duct shall be longitudinal seam duct.
  4. Exhaust Ducts (Negative Pressure): 2-inch wg, round duct shall be longitudinal seam duct.

#### 3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated, see 23 07 13 "Duct Insulation".
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Ducts shall be mounted tight to structure above ceiling.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Exposed duct shall be paintable galvanized duct to be field painted in color specified by architect. Refer to architectural finishes schedule for color.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures. Do not route duct over electrical equipment. Coordinate with Division 26 and offset as required.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Wall Partition Penetrations: Where continuous ducts pass through rated interior partitions provide firestopping sealant. Where ducts are non-continuous and pass through rated wall partitions provide fire dampers. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
- O. Fire-Rated Floor/Ceiling Penetrations: Where ducts pass through rated floor or ceiling assemblies provide fire dampers. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
- P. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction." Any duct system requiring air flow during construction shall be protected at the point of air entering the system with a MERV 8 or higher efficiency filter.

### 3.3 SEAM AND JOINT SEALING

- A. All joints and seams shall be sealed without exception.
- B. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Pressure classifications not requiring sealing shall be sealed with mastic applied to the exterior surface of the joint or seam. Where SMACNA does not require joint sealant apply the sealing process for the closest pressure class requiring sealant.
- C. Seal ducts before external insulation is applied.

### 3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- F. Where visible in occupied areas duct supports shall be uni-strut trapeze type with threaded rods. Paint supports to match duct.

### 3.5 FIELD QUALITY CONTROL

- A. Perform field tests for the following ductwork:
1. Ductwork shall be leak tested as required by ASHRAE Standard 90.1. Ductwork that is designed to operate at static pressures in excess of 3-inch wg and all ductwork located outdoors shall be leak-tested. Refer to mechanical equipment schedules to determine which systems are to operate at static pressures in excess of 3-inch wg.
  2. Maximum allowable leakage shall comply with SMACNA Leakage Class 6 (Maximum Allowable Leakage in  $\frac{\text{CFM}}{100\text{SF}}$  duct surface area =  $L_{\text{max}} = C_L * P^{0.65}$ ). Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested.
  3. Ductwork to be tested shall be tested prior to making taps for air terminal unit connections.
  4. All low pressure supply air ducts, all return air ducts, and all exhaust/energy recovery air ducts do not need to be tested.
  5. Supply ducts downstream of air terminal units do not require pressure testing.
  6. Systems which are to operate at static pressures less than 3-inch wg do not require testing.
- B. Perform the following field tests and inspections according to industry-accepted test procedures described in SMACNA's "HVAC Air Duct Leakage Test Manual" and ASHRAE Standard 90.1, Appendix E and prepare test reports:
1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. Do not pressurize systems above maximum design operating pressure. Give seven days advance notice for testing.
  3. Maximum Allowable Leakage: See 3.5.A.
  4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
- C. Air terminal unit flexible duct connections shall be a maximum 3'-0" in length and shall not exceed 15 degrees in change of direction.
- D. Diffuser, register, and grille flexible duct connections shall be a maximum 8'-0" in length as described in project details.

END OF SECTION





## SECTION 233300-DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Control dampers.
4. Fire dampers.
5. Ceiling fire dampers.
6. Smoke dampers.
7. Combination fire and smoke dampers.
8. Turning vanes.
9. Duct-mounting access doors.
10. Branch duct connectors
11. Flexible connectors.
12. Flexible ducts.
13. Duct accessory hardware.
14. Pressure relief doors.
15. Automatic balancing dampers.

B. See Division 26, Section "Fire Alarm" for duct-mounting fire and smoke detectors for buildings with fire alarm systems. Duct mounted smoke detectors in buildings without fire alarm systems shall be provided by Division 23.

C. See Division 23, Section "Direct Digital Controls" for electric and pneumatic damper actuators.

#### 1.2 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Fire dampers.
4. Ceiling fire dampers.
5. Smoke dampers.
6. Combination fire and smoke dampers.
7. Turning vanes.
8. Duct-mounting access doors.
9. Flexible connectors.
10. Flexible ducts.

- 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. Special fittings.
  2. Manual-volume damper installations.
  3. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors
  4. Wiring Diagrams: Power, signal, and control wiring.

### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## 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, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

### 2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M.

D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.3 BACKDRAFT DAMPERS

### A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
6. Penn Ventilation Company, Inc.
7. Prefco Products, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. Description: Multiple-blade, parallel action gravity balanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners and mounting flange.

D. Blades: 0.050-inch- thick aluminum sheet.

E. Blade Seals: Vinyl.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

## 2.4 VOLUME DAMPERS

### A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. General Description: 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.

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 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. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
  3. Blade Axles: Galvanized steel.
  4. Bearings: Oil-impregnated bronze or molded synthetic.
  5. Tie Bars and Brackets: Galvanized steel.
- D. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## 2.5 DAMPERS

- A. General: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm face velocity through damper and 4-inch wg pressure differential.
- B. Return Air Applications - All damper blades shall not be less than 16 gauge galvanized steel roll formed for high velocity performance. Blades on all dampers shall be 6" wide or less. Blade bearings shall be nylon standard with 1/2" zinc plated steel shafts. All blade linkage hardware shall be of corrosion-resistant finish and readily accessible for maintenance after installation. Neoprene reinforced blade edge seals and spring loaded stainless steel side seals shall be provided to insure leakage of not more than 1% at 1500 fpm approach velocity at 4" static closing to torque. Dampers and seals shall be suitable for temperature ranges of -40 to 200 degrees F.
- C. Outside Air Applications - Extruded aluminum opposed blade construction with edge seals. Provide stainless steel axles, linkages, and bearings. Dampers shall be rated at 6 INWG, 6,000 FPM with maximum leakage of 6 CFM/sqft at 4 INWG.

## 2.6 FIRE DAMPERS

- A. Manufacturers:
1. Air Balance, Inc.
  2. CESCO Products.
  3. Greenheck.
  4. McGill AirFlow Corporation.
  5. METALAIRE, Inc.
  6. Nailor Industries Inc.
  7. Penn Ventilation Company, Inc.
  8. Prefco Products, Inc.
  9. Ruskin Company.
  10. Vent Products Company, Inc.
  11. Ward Industries, Inc.

- B. Fire dampers shall be labeled according to UL 555 for dynamic use.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream unless noted otherwise; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
  - 1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of 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.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Fusible Links: Replaceable, 165 deg F rated unless noted otherwise.

## 2.7 CEILING FIRE DAMPERS

- A. Manufacturers:
  - 1. Air Balance, Inc.
  - 2. CESCO Products.
  - 3. Greenheck.
  - 4. McGill AirFlow Corporation.
  - 5. METALAIRE, Inc.
  - 6. Nailor Industries Inc.
  - 7. Penn Ventilation Company, Inc.
  - 8. Prefco Products, Inc.
  - 9. Ruskin Company.
  - 10. Vent Products Company, Inc.
  - 11. Ward Industries, Inc.
- B. General Description: Labeled according to UL 555C for dynamic use; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Fusible Links: Replaceable, 165 deg F unless noted otherwise.

## 2.8 SMOKE DAMPERS

- A. Manufacturers:
  - 1. Air Balance, Inc.
  - 2. CESCO Products.
  - 3. Greenheck.
  - 4. Nailor Industries Inc.
  - 5. Penn Ventilation Company, Inc.
  - 6. Ruskin Company.
- B. General Description: Labeled according to UL 555S with dynamic rating.
- C. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.
- D. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application.
- E. Damper Motors: Provide 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.
  - 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. Electrical Connection: 115 V, single phase, 60 Hz.
  - 6. Reset: Dampers shall have automatic reset in event of power failure or alarm activation.

## 2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. Cesco Products; a division of Mestek, Inc.
  - 3. Greenheck Fan Corporation.
  - 4. Nailor Industries Inc.
  - 5. Pottorff.
  - 6. Ruskin Company.
  - 7. Metalaire
- B. Dampers shall be rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded corners and mounting flange.

- E. Heat-Responsive Device: Resettable, 165 deg F rated, fusible links.
- F. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.
- G. Rated pressure and velocity to exceed design airflow conditions.
- H. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- I. Damper Motors: Modulating action.
- J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
  - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  - 4. 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 and breakaway torque rating of 150 in. x lbf.
  - 5. Outdoor Motors and Motors in Outdoor-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.
  - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
  - 7. Electrical Connection: 115 V, single phase, 60 Hz.
  - 8. Smoke Detector: Provided by fire alarm contractor. See Division 26 specifications.
- K. Accessories:
  - 1. Auxiliary switches for signaling.
  - 2. Test and reset switches, remote mounted.
  - 3. See section 3.1 for duct access door requirements.

## 2.10 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, **double**-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.

- b. Duro Dyne Corp.
- c. METALAIRE, Inc.
- d. Ward Industries, Inc.

- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.11 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

### 1. Manufacturers:

- a. American Warming and Ventilating.
- b. CESCO Products.
- c. Ductmate Industries, Inc.
- d. Flexmaster U.S.A., Inc.
- e. Greenheck.
- f. McGill AirFlow Corporation.
- g. Nailor Industries Inc.
- h. Ventfabrics, Inc.
- i. Ward Industries, Inc.

### 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

### 3. Provide number of hinges and locks as follows:

- a. Less Than 12 Inches Square: Secure with two sash locks.
- b. Up to 18 Inches Square: Two hinges and two sash locks.
- c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.

- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

### 1. Manufacturers:

- a. Flexmaster U.S.A., Inc.

### 2. Frame: Galvanized sheet steel, with spin-in notched frame.

- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

- E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

## 2.12 BRANCH DUCT CONNECTORS



- A. Manufacturers:
  - 1. Ductmate Industries, Inc.
  - 2. Flexmaster U.S.A., Inc.
  - 3. Hart & Cooley, Inc.
  - 4. McGill AirFlow Corporation.
  
- B. Spin Fittings: 26 gauge G90 Galvanized steel constructed as per ASTM A653 CS, Type B. Provide manual damper with insulation stand-off and locking hand quadrant. Overall length shall be 7" including damper. Unless noted otherwise, spin fitting shall be utilized at all branch duct taps where branch duct is one size or less that the trunk duct.
  
- C. Side Takeoff Fittings: 26 gauge G90 galvanized steel construction with 45 degree angle. Maintain 1:1 ratio of inlet and outlet on all units over 7" diameter. Provide 1" offset rear edge and 1" wide mounting flange with corner clips and adhesive gasket. Provide manual damper with insulation stand-off and locking hand quadrant. Overall length shall be 13" including damper. Unless noted otherwise, side takeoff fittings shall be utilized at all branch duct taps where branch duct is same or larger size than trunk duct.

#### 2.13 FLEXIBLE CONNECTORS

- A. Manufacturers:
  - 1. Duro Dyne Corp.
  - 2. Ventfabrics, Inc.
  - 3. Ward Industries, Inc.
  
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
  
- C. Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd.
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.

#### 2.14 FLEXIBLE DUCTS

- A. Manufacturers:
  - 1. Ductmate Industries, Inc.
  - 2. Flexmaster U.S.A., Inc.
  - 3. Hart & Cooley, Inc.
  - 4. McGill AirFlow Corporation.
  
- B. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm .
3. Temperature Range: Minus 10 to plus 160 deg F.

- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

#### 2.15 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

#### 2.16 PRESSURE RELIEF DOORS

- A. General Description: Factory set spring loaded pressure relief doors, airtight and suitable for duct pressure class. Doors shall provide positive or negative pressure relief in accordance to the system duct pressure under normal operating parameters.
1. Manufacturers:
    - a. KEES, Inc.
    - b. Ruskin
- B. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness.
- C. Seal around door to frame with neoprene gasket.
- D. Spring: Spring shall be factory set to rated duct pressure and provide automatic door closure upon relieving the pressure.

#### 2.17 AUTOMATIC BALANCING DAMPERS

- A. General Description: Pressure independent automatic airflow regulating air valve for exhaust or supply application. Thermoplastic or galvanized steel fabrication, UL2043 tested for heat and smoke emissions.
1. Manufacturers:
    - a. Automatic Balancing Valves
    - b. Ruskin
    - c. Aldes
- B. Damper: Same material as housing with full circumference rubber gasket seal and stainless leaf spring.

- C. Features:
1. Tool-free field adjustable flow setting.
  2. Anti-microbial agent (thermoplastic only).
  3. Sealed bearings.
  4. Field convertible flow direction.
  5. .2 - .8 inwg pressure range.
  6. 10% accuracy between 50-100 CFM.

## PART 3 - EXECUTION

### 3.1 APPLICATION AND INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
1. On both sides of duct coils.
  2. Downstream from volume dampers and equipment.
  3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
  4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
  5. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:

1. Duct access panel shall be square, 2" smaller than duct height for side access and 2" smaller than width for bottom or top access. Maximum access panel size shall be 18" x 18".
- J. Install the following sizes for duct-mounting, round access doors:
1. Duct access panels shall be manufactured oval shape to match duct size.
- K. Label access doors according to Division 23 Section "Mechanical Identification."
- L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- M. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- O. Connect diffusers or light troffer boots to low pressure ducts with maximum 72-inch (1500-mm) lengths of flexible duct clamped or strapped in place. Maintain minimum 1.5R bend in flex.
- P. Connect flexible ducts to metal ducts with adhesive plus draw bands.
- Q. Install duct test holes where indicated and required for testing and balancing purposes.
- R. Provide self closing spring loaded pressure relief doors in supply and return duct mains for any unit producing more that 2" external static pressure. The relief damper shall be located in the main ducts between the unit and the first set of automatic or fire/smoke protection dampers and shall be factory set to open at the rated pressure of the duct system. Unless noted otherwise on the plans, the damper shall be the maximum size that the duct can accommodate up to 24x24.
- S. Provide turning vanes for changes in direction exceeding 30 degrees.
- T. Install duct mounted smoke detectors provided by fire alarm contractor.

### 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 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

## SECTION 233423 - POWER VENTILATORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Ceiling-mounting ventilators.
  - 2. Roof mounted centrifugal fans.

#### 1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material gages and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
  - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Operation and maintenance data.

#### 1.3 QUALITY ASSURANCE AND CODES AND STANDARDS

- 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.
- E. ANSI/ASHRAE Standard 52.2-1999, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size."
- F. NFPA Standard 68-2007, "Standard on Explosion Protection by Deflagration Venting".

#### 1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Belts: One set for each belt-driven unit.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraphs titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into project.

### 2.2 CEILING-MOUNTING VENTILATORS

- A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.
  - 1. Manufacturers:
    - a. Twin City Fan Companies, Ltd.
    - b. Cook, Loren Company.
    - c. Greenheck Fan Corp.
    - d. Penn Ventilation Companies, Inc.
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- F. Accessories:
  - 1. Hanging kit with vibration isolators.
  - 2. Fan speed controller.
  - 3. Square to round duct connection.
  - 4. Backdraft damper.

### 2.3 ROOF MOUNTED CENTRIFUGAL FANS

- A. Description: Belt-driven or direct-driven fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
  - 1. Manufacturers:
    - a. Twin City Fan Companies, Ltd.
    - b. Cook, Loren Company.
    - c. Greenheck Fan Corp.
    - d. Penn Ventilation Companies, Inc.

- B. Housing: Removable, spun-aluminum, dome top and outlet baffle extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.
- C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:
  - 1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
  - 2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
  - 3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
  - 4. Fan and motor isolated from exhaust airstream.
  - 5. Automatic belt tensioners.
- E. Accessories:
  - 1. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
  - 2. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
  - 3. Self-tensioning 3-pulley fan belt system (for belt driven fans only).
- F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
  - 1. Configuration: Built-in cant and mounting flange.
  - 2. Overall Height: 12 inches.
  - 3. Pitch Mounting: Manufacture curb for roof slope.
  - 4. Metal Liner: Galvanized steel.

## 2.4 EXECUTION

## 2.5 INSTALLATION

- A. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Through bolt roof curbs to roof deck with angle iron backer.
- B. Support suspended units from structure using threaded steel rods and spring hangers. Vibration-control devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 23 Section "Mechanical Identification."
- E. Refer to Division 23 "HVAC General Requirements" for HVAC system protection requirements during construction.
- F. Install system in accordance with manufacturer's instructions. Manufacturer's installation instructions are indicated in the IOM provided with all equipment.

## 2.6 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

## 2.7 FIELD QUALITY CONTROL

- A. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- E. Replace fan and motor pulleys as required to achieve design airflow. Fan drive replacement shall be included in the base bid.
- F. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

END OF SECTION



## SECTION 233713-DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: General air device requirements. Refer to schedule for air device applications.
- B. Related Sections:
  - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples: For each exposed product and for each color and texture specified.

### PART 2 - PRODUCTS

#### 2.1 AIR DEVICES

- A. Insert number to complete drawing designation for each product required. Use these designations on Drawings to identify each product.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Anemostat Products; a Mestek company.
    - b. Carnes.
    - c. Hart & Cooley Inc.
    - d. METALAIRE, Inc.
    - e. Nailor Industries Inc.
    - f. Price Industries.
    - g. Titus.
    - h. Tuttle & Bailey.

## 2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb. Air devices shall be installed at finishing phase for each phase.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Refer to Division 23 "HVAC General Requirements" for HVAC system protection requirements during construction.

### 3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

## SECTION 235100-BREECHINGS, CHIMNEYS, AND STACKS

### PART 1 - GENERAL

#### 1.1 RELATED WORK

- A. Refer to other sections of Division 15 for gas fired equipment and accessories associated with gas fired equipment.
- B. Refer to Division 15 Section "Metal Duct" for kitchen hood grease duct and dishwasher hood exhaust duct.

#### 1.2 SUMMARY

- A. This Section specifies the following:
  - 1. Double wall pressure pipe metal vents and accessories for categories II, III and IV gas fired appliances.
  - 2. PVC vents

#### 1.3 SUBMITTALS

- A. Product Data: Submits product data including materials, dimensions, weights, and accessories for the following:
  - 1. Double wall (condensing boiler) vents.
  - 2. PVC vents
- B. Shop Drawings: Submits detailed layout shop drawings, plans and elevations, including required clearances, assembly and installation instructions, and support of components.
- C. Quality Control Submittals:
  - 1. Certificates: When applicable - Submit certificates of materials compliance with specified ASTM, UL, and ASHRAE requirements.
  - 2. Certificates: When applicable - Submit complete engineering report certifying that stacks meet the design wind and seismic loads.

#### 1.4 QUALITY ASSURANCE

- A. Welder's Qualifications: All welders shall be certified in accordance with AWS Standard D9.1, Specifications for Welding Sheet Metal.
- B. Codes and Standards:
  - 1. NFPA: Comply with NFPA 211 "Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances."
  - 2. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.

3. SMACNA: Comply with SMACNA Low Pressure Duct Standards for fabricated breeching and smoke pipe.
4. AWS: Comply with AWS Structural Welding Code for welder's qualifications, welding details, and workmanship standards.
5. ASHRAE: Comply with the ASHRAE Equipment Handbook for Chimney, Gas Vent, and Fireplace Systems, material requirements and design criteria.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. American Metal Products; MASCO Corporation.
  2. Hart & Cooley, Inc.
  3. Heat-Fab Inc.
  4. Metal-Fab, Inc.
  5. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
  6. Simpson Dura-Vent Co., Inc.; Subsidiary of Simpson Manufacturing Co.
  7. Tru-Flex Metal Hose Corp.
  8. Cheminee Lining.E Inc, model HEPL2 - local contact New & Associates, phone 504-833-2700
  9. Van-Packer Inc.

### 2.2 DOUBLE WALL METAL (CONDENSING BOILER) VENTS

- A. Description: All stainless steel, positive pressure, double wall stack.
- B. The UL listed factory built breeching system shall be made in accordance with NFPA 211. This stack system shall be designed and installed to be gas tight. It shall be UL 1738 Listed to withstand up to 15" w.c. positive pressures. This breeching system shall be designed to compensate for all flue gas induced thermal expansions. The breeching shall be HEPL2 or approved equivalent. For safety reasons, breeching shall be double walled containing 2" mineral fiber insulation. Clearances to combustible materials shall be per installation instructions.
- C. The joint assembly shall be a male/female slip-type jointing with flange to flange and V-band assembly. An internal sleeve serves for readily alignment as well as long term joint seal protection from condensate, water and flue gas temperature. Non-slip type joints are not acceptable.
- D. The inner wall stack is made of an inner gas carrying pipe of 24 gauge type AL29-4C stainless steel. The outer wall must be of 24 gauge 304 stainless steel. The insulation between inner and outer shell shall be 2" mineral fiber insulation. The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL Listing.
- E. The entire stack system from each boiler to the termination, including accessories, shall be from one manufacturer.

- F. The breeching and stack shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of 10 years from the date of delivery.
- G. Drawings showing the actual layout and drawn to scale shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's 10 year warranty and in conjunction with sound engineering practice.
- H. The inner diameter for breeching and stack shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow ASHRAE calculation methods and incorporate the specific flow characteristics of the inner pipe.
- I. Technical services supports. The factory built modular stack system shall be furnished by a vendor organization which assures design, installation and service coordination and provides in-warranty and post warranty unified responsibility for owner.

### 2.3 PVC VENTS AND COMBUSTION AIR INTAKE

- A. Solid wall, schedule 40 PVC pipe and fittings.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Vents and combustion air intake materials shall be in accordance with manufacturer recommendations.

### 3.2 INSTALLATION OF LISTED VENTS AND CHIMNEYS

- A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.
- D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- E. For condensing applications, provide a drain and neutralization basin at low point in vent stack system. Route discharge to nearest drain.

### 3.3 INSTALLATION OF BREECHINGS, AND VENTS

- A. The stack system shall be installed according to the stack manufacturer's installation instructions and appliance manufacturer requirements. The joining of pipe sections must be made using the assembly band, the finishing band and the appropriate sealing material. Roof penetrations shall be suitable for a combustible roof and shall be according to the manufacturer's detail drawings and installation instructions.
- B. Provide factory roof collar and ventilated flashing at roof penetration as per manufacturer recommendations.
- C. When installed according to the manufacturer's installation instructions the stack and its supporting system shall resist side loads at least 1.5 times the weight per foot of piping.
- D. Follow factory recommended minimum lengths and terminations to prevent false alarms on combustions air flow caused by wind backpressure.
- E. Concentric vent/intake terminations are acceptable where approved by appliance manufacturer.

END OF SECTION

## SECTION 237416 – SINGLE ZONE HEAT PUMP ROOFTOP AIR-CONDITIONING UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes packaged, small-capacity, rooftop air-conditioning units (RTUs) with the following components:
  1. Casings.
  2. Fans, drives, and motors.
  3. Coils.
  4. Refrigerant circuit components.
  5. Electrical power connections.
  6. Controls.
  7. Roof curbs.

#### 1.3 DEFINITIONS

- A. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, small-capacity, rooftop air-conditioning units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each RTU.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
  3. Include unit dimensions and weight.
  4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
  5. Fans:
    - a. Include certified fan-performance curves with system operating conditions indicated.
    - b. Include certified fan-sound power ratings.
    - c. Include fan construction and accessories.
    - d. Include motor ratings, electrical characteristics, and motor accessories.
  6. Include certified coil-performance ratings with system operating conditions indicated.

7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, small-capacity, rooftop air-conditioning unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Filters: One set(s) of filters for each unit.
2. Gaskets: One set(s) for each access door.
3. Filters: One set(s) of filters for each unit.

## 1.7 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of outdoor, semi-custom, air-handling unit that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of RTUs and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 Compliance: For refrigeration system safety.



- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance: Comply with UL 1995.

## 2.2 CAPACITIES AND CHARACTERISTICS

- A. Compressors:
  - 1. Number of Refrigerant Circuits: One.
  - 2. Compressor Speed: Single.
  - 3. Seasonal Energy-Efficiency Ratio (SEER): Shall meet or exceed scheduled SEER ratings and ASHRAE 90.1 2007, whichever is greater.
  - 4. Heat Pump.
- B. Recirculating-Air Filters:
  - 1. Depth: 2 inches.
  - 2. Access Location: Side.
  - 3. Minimum Efficiency Reporting Value:
    - a. MERV Rating: MERV 8, according to ASHRAE 52.2.

## 2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced single-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Single Wall Construction:
  - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 2. Floor Plate: G90 galvanized steel, minimum 18 gauge thick.
  - 3. Casing Insulation:
    - a. Materials: Flexible fiber glass insulation (1.5# density)
    - b. Insulation Thickness: 1/2 inch.
    - c. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. Static-Pressure Classifications:
  - 1. For Unit Sections Upstream of Fans: Minus 2-inch wg.
  - 2. For Unit Sections Downstream and Including Fans: 2-inch wg.

E. Panels and Doors:

1. Panels:

- a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
- b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
- c. Gasket: Neoprene, applied around entire perimeters of panel frames.
- d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

2. Access Doors:

- a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
- b. Gasket: Neoprene, applied around entire perimeters of panel frames.
- c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

3. Locations and Applications:

- a. Fan Section: Inspection and access panels.
- b. Coil Section: Inspection and access panels.
- c. Damper Section: Inspection and access panels.
- d. Filter Section: Inspection and access panels large enough to allow periodic removal and installation of filters.

F. Condensate Drain Pans:

1. Location: Each type of cooling coil.

2. Construction:

- a. Single-wall, galvanized steel sheet.

3. Drain Connection:

- a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
- b. Minimum Connection Size: NPS 3/4.

4. Slope: Minimum 0.125-in./ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.

5. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.

6. Width: Entire width of water producing device.

7. Depth: A minimum of 2 inches deep.

## 2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.
  - 1. Shafts: With field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway.
  - 2. Shaft Bearings:
    - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.
  - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
    - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  - 4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
  - 5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  - 6. Shaft Lubrication Lines: Extended to a location outside the casing.
- C. Drives, Direct: Factory-mounted, direct drive.
- D. Condenser-Coil Fan: propeller, mounted on shaft of permanently lubricated ECM motors.
- E. Motors:
  - 1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 3. Enclosure Type: Open, drip proof.
  - 4. Enclosure Materials: Cast iron.
  - 5. Efficiency: Premium efficient as defined in NEMA MG 1.
  - 6. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

## 2.5 COILS

- A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils shall not act as structural component of unit.

B. Supply-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
  - b. Fin Spacing: Maximum: 16 fins per inch.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.

C. HEAT PUMP HEATING

1. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heat pump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heat pump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
2. The refrigerant system shall have a pump-down cycle.
3. The unit shall have an electric resistance heating coil for auxiliary heating. When the heat pump operation cannot maintain the discharge air temperature setpoint the electric heating coil shall temper the airstream to the discharge air temperature setpoint

D. AUXILIARY HEATING SECTION

1. The rooftop unit shall include an electrical resistance heating coil section. Staged electric heating coil modules shall be factory installed downstream of the supply air fan in the heating section of the rooftop unit. Heating coils shall be constructed of a low watt density, nickel-chromium alloy resistance wire with intermediate supports that include ceramic bushings. The electrical contactors shall be of the full line-breaking type with all the electrical power legs being disconnected when the contactors are not energized. All electrical circuit wiring shall be designed with copper conductors, aluminum wires are not acceptable. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements. The power supply for the electric heater shall be factory wired into the units main power block or disconnect switch.
2. The heating modules shall have an automatic reset, high temperature limit safety protection. A secondary high limit protection shall also be provided that requires a manual reset. An airflow switch shall be provided with the heating module to prevent the electric heater from operating in the event of no airflow.
3. The electric heat elements shall be controlled by the factory installed DDC unit control system. The heater shall have proportional SCR control. The unit controller shall modulate the electric heater to maintain the discharge air temperature setpoint.
4. Field installed heating modules shall require a field ETL certification. Duct heaters mounted within the rooftop unit in the field shall not be acceptable. The manufacturer's

rooftop unit ETL certification shall cover the complete unit including the electric heating modules

## 2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- B. Refrigeration Specialties:
  - 1. Refrigerant: R-410A.
  - 2. Expansion valve with replaceable thermostatic element.
  - 3. Refrigerant filter/dryer.
  - 4. Manual-reset high-pressure safety switch.
  - 5. Automatic-reset low-pressure safety switch.
  - 6. Minimum off-time relay.
  - 7. Automatic-reset compressor motor thermal overload.
  - 8. Brass service valves installed in compressor suction and liquid lines.
  - 9. Low-ambient kit high-pressure sensor.

## 2.7 AIR FILTRATION

- A. Panel Filters:
  - 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
  - 2. Filter Unit Class: UL 900.
  - 3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
  - 4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.

## 2.8 ELECTRICAL POWER CONNECTIONS

- A. RTU shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.
- B. Through the base electrical connection.

## 2.9 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
- B. Interface Requirements for HVAC Instrumentation and Control System:
  - 1. Interface relay for scheduled operation.
  - 2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.

3. Provide BACnet compatible interface for central HVAC control workstation for the following:
  - a. Adjusting set points.
  - b. Monitoring supply fan start, stop, and operation.
  - c. Monitoring occupied and unoccupied operations.

#### 2.10 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
  1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    - a. Materials: ASTM C1071, Type I or II.
    - b. Thickness: 1-1/2 inches.
  2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
    - a. Liner Adhesive: Comply with ASTM C916, Type I.
    - b. 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 cabinet.
    - c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
- B. Curb Dimensions: Height of 14 inches.

#### 2.11 ACCESSORIES

- A. Low-ambient kit using staged condenser fans for operation down to 35 deg F.
- B. Hail guards of galvanized steel, painted to match casing.

#### 2.12 MATERIALS

- A. Steel:
  1. ASTM A36/A36M for carbon structural steel.
  2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
  1. Manufacturer's standard grade for casing.
  2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.

### 2.13 SOURCE QUALITY CONTROL

- A. AHRI Compliance:
  - 1. Comply with AHRI 210/240 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with AHRI 340/360 for testing and rating energy efficiencies for RTUs.
  - 3. Comply with AHRI 270 for testing and rating sound performance for RTUs.
  - 4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- B. AMCA Compliance:
  - 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
  - 2. Damper leakage tested according to AMCA 500-D.
  - 3. Operating Limits: Classify according to AMCA 99.

## 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 RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "NRCA Roofing Manual: Membrane Roof Systems." Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.

### 3.3 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.

2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 "Duct Accessories."
4. Install return-air duct continuously through roof structure.

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect electrical wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

### 3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  1. Complete installation and startup checks according to manufacturer's written instructions.
  2. Inspect for visible damage to unit casing.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Clean condenser coil and inspect for construction debris.
  10. Remove packing from vibration isolators.
  11. Verify lubrication on fan and motor bearings.
  12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  13. Start unit according to manufacturer's written instructions.



- a. Start refrigeration system.
  - b. Do not operate below recommended low-ambient temperature.
  - c. Complete startup sheets and attach copy with Contractor's startup report.
14. Inspect and record performance of interlocks and protective devices; verify sequences.
  15. Operate unit for an initial period as recommended or required by manufacturer.
  16. Adjust and inspect high-temperature limits.
  17. Simulate maximum cooling demand and inspect the following:
    - a. Compressor refrigerant suction and hot-gas pressures.
    - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
  18. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

### 3.8 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

### 3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

### 3.10 DEMONSTRATION

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

END OF SECTION



## SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes factory-assembled, dedicated outdoor air-handling units, including multiple components, capable of heating and cooling 100 percent outdoor air.

#### 1.3 DEFINITIONS:

- A. ECM: Electronically commutated motor.
- B. IS COP: Integrated Seasonal Coefficient of Performance.
- C. ISMRE: Integrated Seasonal Moisture Removal Efficiency.
- D. MRC: Moisture Removal Capacity.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each dedicated outdoor-air unit.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Include unit dimensions and weight.
  - 4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
  - 5. Fans:
    - a. Certified fan-performance curves with system operating conditions indicated.
    - b. Certified fan-sound power ratings.
    - c. Fan construction and accessories.
    - d. Motor ratings, electrical characteristics, and motor accessories.
  - 6. Include certified coil-performance ratings with system operating conditions indicated.
  - 7. Include filters with performance characteristics.
  - 8. Include heat exchangers with performance characteristics.
  - 9. Include dampers, including housings, linkages, and operators.

- B. Shop Drawings: For each dedicated outdoor-air unit.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters: One set for each unit.
  - 2. Gaskets: One set for each access door.

#### 1.7 WARRANTY

- A. Warranty: Manufacturer agrees to replace components of dedicated outdoor-air units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Dedicated Outdoor-Air-Handling Units: Two years from date of Substantial Completion.
  - 2. Warranty Period for Compressors: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory), and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.

- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance:
  - 1. Electric Coils: Comply with requirements in UL 1995.

## 2.2 CAPACITIES AND CHARACTERISTICS

- A. Filters:
  - 1. Type: Pleated.
  - 2. Depth: 4 inches.
  - 3. Access Location: Side.
  - 4. Minimum Efficiency Reporting Value:
    - a. MERV Rating: MERV 8, in accordance with ASHRAE 52.2.

## 2.3 MANUFACTURERS

- A. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

## 2.4 UNIT CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Configuration: Horizontal unit with bottom discharge for roof-mounting installation.
- C. Double-Wall Configuration:
  - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with manufacturer's standard finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
  - 2. Inside Casing Wall:
    - a. Inside Casing, All Other Sections: Galvanized steel, solid.
  - 3. Floor Plate: Reinforced metal surface; reinforced to limit deflection when walked on by service personnel. Insulation is provided below metal walking surface.
  - 4. Roof: Standing seam or membrane; sloped to drain water.
  - 5. Casing Insulation:
    - a. Materials: Polyurethane foam insulation.
    - b. Casing Panel R-Value: Minimum R-13.
    - c. Insulation Thickness: 2 inches.

- d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.
- D. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- E. Static-Pressure Classifications:
- 1. For Unit Sections Upstream of Fans: Minus 2 inches wg.
  - 2. For Unit Sections Downstream and Including Fans: 2 inches wg.
- F. Panels and Doors:
- 1. Panels:
    - a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
    - b. Fasteners: Two or more camlock-type fasteners for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
    - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    - d. Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components
  - 2. Doors:
    - a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
    - b. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
    - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    - d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.
  - 3. Locations and Applications:
    - a. Fan Section: Doors.
    - b. Access Section: Doors.
    - c. Filter Section: Doors large enough to allow periodic removal and installation of filters.
- G. Condensate Drain Pans:
- 1. Location: Each refrigerant coil.
  - 2. Construction:
    - a. Single-wall, stainless steel sheet.
  - 3. Size: Large enough to collect condensate from cooling coils, including coil piping connections, coil headers, and return bends.
  - 4. Drain Connection:

- a. Located on both ends of pan, at lowest point of pan.
  - b. Terminated with threaded nipple.
  - c. Minimum Connection Size: NPS 1.
5. Slope: Minimum 0.125-inch/ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
  6. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
  7. Width: Entire width of water-producing device.
  8. Depth: A minimum of 2 inches deep.

## 2.5 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans and Relief-Air Fans: Centrifugal; galvanized or painted steel; mounted on solid-steel shaft.
  1. Shafts: With field-adjustable alignment.
    - a. Turned, ground, and polished hot-rolled steel with keyway.
  2. Shaft Bearings:
    - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.
  3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
    - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
  4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.
  5. Mounting: For internal vibration isolation. Factory mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
  6. Shaft Lubrication Lines: Extended to a location outside the casing.
- C. Drive, Direct: Factory-mounted direct drive.
- D. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated electronically commutated motors.
- E. Motors:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  3. Enclosure Type: Open, dripproof.
  4. Enclosure Materials: Cast iron.
  5. Efficiency: Premium efficient as defined in NEMA MG 1.
  6. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
  7. Mount unit-mounted disconnect switches on exterior of unit.
- F. Comply with Section 262923 "Variable-Frequency Motor Controllers."

## 2.6 COILS

### A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils are not to act as structural component of unit.

### B. Supply-Air Refrigerant Coils:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
  - b. Fin Spacing: Maximum 14 fins per inch.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Stainless Steel
6. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.
  - a. Working Pressure: Minimum 300 psig.

### C. Hot-Gas Reheat Refrigerant Coils:

1. Tubes: Copper.
2. Fins:
  - a. Material: Aluminum.
  - b. Fin Spacing: Maximum 10 fins per inch.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.



- a. Working Pressure: Minimum 300 psig.
7. Suction-discharge bypass valve.
  
- D. Electric-Resistance Heating Coils: Comply with UL 1995.
  1. Casing Assembly: Slip-in] type with galvanized-steel frame.
  2. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
  3. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
  4. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
  5. Control Panel: Unit mounted with disconnecting means and overcurrent protection.
    - a. Magnetic contactor.
    - b. Toggle switches, one per step.
    - c. SCR controller.
    - d. Time-delay relay.
    - e. Pilot lights, one per step.
    - f. Airflow proving switch.
  
- E. Condenser Refrigerant coils:
  1. Tube Material: Copper.
  2. Fin Material: Aluminum.
  3. Fin and Tube Joint: Mechanical bond.

## 2.7 REFRIGERATION CIRCUIT COMPONENTS

- A. Compressors: Hermetic, variable-speed scroll compressors, mounted on integral vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
  
- B. Refrigerant: R-410A.
  
- C. Refrigeration Specialties:
  1. Expansion valve with replaceable thermostatic element.
  2. Refrigerant filter/dryer.
  3. Manual-reset high-pressure safety switch.
  4. Automatic-reset low-pressure safety switch.
  5. Minimum off-time relay.
  6. Automatic-reset compressor motor thermal overload.
  7. Thermostat for coil freeze-up protection during low-ambient-temperature operation or loss of air.
  8. Brass service valves installed in discharge and liquid lines.
  9. Low-ambient kit high-pressure sensor.
  10. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
  11. Modulating hot-gas reheat solenoid valve with a replaceable magnetic coil.

## 2.8 AIR FILTRATION

### A. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

### B. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Cartridge filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

## 2.9 DAMPERS

- ### A. Outdoor-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in parallel-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1 inch wg and 8 cfm/sq. ft. at 4 inches wg.

### B. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
2. Electronic damper position indicator shall have visual scale indicating percentage of travel and 2 to 10 V dc feedback signal.
3. Operator Motors:
  - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
  - c. 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.
4. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
5. Size dampers for running torque calculated as follows:
  - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
6. Coupling: V-bolt and V-shaped, toothed cradle.

7. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
8. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.
9. Power Requirements (Two-Position Spring Return): 24 V dc.
10. Proportional Signal: 2 to 10 V dc or 4 to 20 mA, and 2 to 10 V dc position feedback signal.
11. Temperature Rating: Minus 22 to plus 122 deg F.
12. Run Time: 30 seconds.

## 2.10 ELECTRICAL POWER CONNECTIONS

- A. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power connection to unit.
- B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.
- C. Wiring: Numbered and color-coded to match wiring diagram.
- D. Wiring Location: Install factory wiring outside an enclosure in a raceway.
- E. Power Interface: Field power interface to be NEMA KS 1, heavy-duty, nonfused disconnect switch.
- F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:
  1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
  2. NEMA KS 1, heavy-duty, nonfusible switch.
  3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- G. Factory-Mounted, Overcurrent-Protection Service: For each motor.
- H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.
- I. Controls: Factory wire unit-mounted controls where indicated.
- J. Control Relays: Auxiliary and adjustable time-delay relays.

## 2.11 CONTROLS

- A. Comply with requirements in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" and Section 230993.11 "Sequence of Operations for HVAC DDC" for control equipment and sequence of operation.
- B. Control Wiring: Factory wire connection for controls' power supply.

- C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.
  
- D. Unit-Mounted Status Panel:
  - 1. Cooling/Off/Heating Controls: Control operational mode.
  - 2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
  - 3. Status Lights:
    - a. Filter dirty.
    - b. Fan operating.
    - c. Cooling operating.
    - d. Heating operating.
    - e. Smoke alarm.
    - f. General alarm.
  - 4. Digital Numeric Display:
    - a. Outdoor airflow.
    - b. Supply airflow.
    - c. Outdoor dry-bulb temperature.
    - d. Outdoor dew point temperature.
    - e. Space temperature.
    - f. Supply temperature.
    - g. Space relative humidity.
    - h. Space carbon dioxide level.
  
- E. Refrigeration System Controls:
  - 1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb (adjustable) of dry air or outdoor-air temperature is less than 60 deg F (adjustable).
  
- F. Electric-Resistance Heat Controls:
  - 1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.
  - 2. Capacity Controls: Modulating SCR.
  
- G. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC." Links shall include the following:
  - 1. Start/stop interface relay and relay to notify DDC temperature-control system alarm condition.
  - 2. Hardware interface or additional sensors for the following:
    - a. Room temperature.
    - b. Discharge-air temperature.
    - c. Refrigeration system operation.

- H. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display unit status and alarms.
  - 1. Hardwired Points:
    - a. Monitoring: On-off status, common trouble alarm.
    - b. Control: On-off operation, space temperature set-point adjustment, space humidity set-point adjustment.
  - 2. ASHRAE 135 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the DDC system for HVAC.

## 2.12 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-resistant coating, watertight gaskets, and factory-installed wood nailer; complying with National Roofing Contractors Association manuals for the specific type of roofing applicable to the Project.
  - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
    - a. Materials: ASTM C1071, Type I or II.
    - b. Thickness: 1-1/2 inches.
  - 2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
    - a. Liner Adhesive: Comply with ASTM C916, Type I.
    - b. 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 cabinet.
    - c. Liner materials applied in this location shall have airstream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric, depending on service air velocity.
- B. Curb Dimensions: Height of 14 inches.

## 2.13 INTAKE AND RELIEF OPENINGS

- A. Type: Manufacturer's standard hood or louver, including moisture eliminator, at all unit intake and relief openings.
- B. Materials: Match material and finish of casing exterior.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

## 2.14 MATERIALS

### A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

### B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

### C. Galvanized Steel: ASTM A653/A653M.

### D. Aluminum: ASTM B209.

## 2.15 SOURCE QUALITY CONTROL

### A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.

### B. AHRI 260 or AMCA 311 Certification: Test and rate air-handling unit fan sound ratings in accordance with AHRI 260 or AMCA Publication 311.

### C. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.

1. AMCA Certification: Test and rate in accordance with AMCA Publication 211.

### D. Damper Leakage and Air Performance: Factory test dampers for leakage and air performance.

1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.

### E. Refrigerant Coils: Factory tested to minimum 300 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

#### B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

#### C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Roof Curb: Install on roof structure or concrete base, level and secure, in accordance with NRCA's "The NRCA Roofing Manual: Membrane Roof Systems. Install units on curbs and coordinate roof penetrations and flashing with roof construction. Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts. Coordinate sizes and locations of roof curbs with actual equipment provided.
- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- D. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 233300 "Air Duct Accessories."
- E. Install separate devices furnished by manufacturer and not factory installed.
- F. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

### 3.3 PIPING CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to units, allow space for service and maintenance.
- C. Connect piping to units mounted on vibration isolators with flexible connectors.
- D. Refrigerant Piping: Comply with applicable requirements in Section 232300 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.
- E. Duct Connections:
  - 1. Comply with requirements in Section 233113 "Metal Ducts."
  - 2. Drawings indicate the general arrangement of ducts.
  - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.
  - 2. Verify operation of remote panel, including pilot-light operation and failure modes. Inspect the following:
    - a. High-limit heat exchanger.
    - b. Alarms.
  - 3. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
  - 4. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:
    - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    - c. Condenser coil entering-air dry-bulb temperature.
    - d. Condenser coil leaving-air dry-bulb temperature.
  - 5. Simulate maximum cooling demand and inspect the following:
    - a. Compressor refrigerant suction and hot-gas pressures.
    - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
  - 6. Inspect casing insulation for integrity, moisture content, and adhesion.
  - 7. Verify that clearances have been provided for servicing.
  - 8. Verify that controls are connected and operable.
  - 9. Verify that filters are installed.
  - 10. Clean coils and inspect for construction debris.
  - 11. Inspect and adjust vibration isolators and seismic restraints.
  - 12. Verify bearing lubrication.



13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Start unit.
15. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
16. Operate unit for run-in period.
17. Calibrate controls.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke.
20. Verify operational sequence of controls.
21. Measure and record the following airflows. Plot fan volumes on fan curve.

a. Supply-air volume.

- B. After startup, change filters, verify bearing lubrication, and adjust belt tension.
- C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.

### 3.7 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

### 3.8 CLEANING

- A. After completing system installation; testing, adjusting, and balancing dedicated outdoor-air unit and air-distribution systems; and completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.

### 3.9 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

### 3.10 DEMONSTRATION

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

END OF SECTION



## SECTION 238126 - MINI SPLIT SYSTEMS

### PART 1- GENERAL

#### 1.01 SYSTEM DESCRIPTION

Variable capacity, inverter driven, heat/cool model, heat pump, cooling only, split systems. The system shall consist of a ceiling cassette, FCU, wall mounted, or convertible AHU configuration as scheduled matched to an air cooled heat pump or condensing unit. The outdoor unit is a horizontal or vertical discharge, variable speed, single or double fan unit. The system shall have a self-diagnostic function, 3-minute time delay mechanism and have a factory pre-charge of R-410A for standard line set length. The system shall have automatic restart capability after a power failure has occurred and a low voltage cut-off feature to prevent stalling during power supply issues.

#### 1.02 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL), in accordance with ANSI/UL 1995 / CSA C22.2 No. 236 – Heating and Cooling Equipment and bear the Listed Mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. Each combination shall be rated in accordance with Air Conditioning Refrigeration Institute's (ARI) Standard 210/240 and bear the ARI label.
- D. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.
- E. A holding charge of dry nitrogen shall be provided in the evaporator.
- F. System Efficiency shall meet or exceed scheduled SEER ratings and ASHRAE 90.1 2007, whichever is greater.

#### 1.03 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendations.

### PART 2 – WARRANTY

#### 2.01 LIMITED WARRANTY

Manufacturer warranty, which warrants all parts of this heating or air conditioning unit, as described below.

- A. This warranty shall cover defects in materials and workmanship that appear under normal use and maintenance for a period of 5 years. Warranty coverage begins on the "installation date". The installation date is one of two dates: (1) The installation date is the date that the unit is originally installed. (2) If the date the unit is originally installed cannot be verified, the installation date is three months after the manufacture date. The warranty shall cover materials and labor.

#### 2.03 INSTALLATION REQUIREMENTS

Installation must comply with the manufacturer's installation manual.

### PART 3 – PERFORMANCE

- 3.02 The operating range in cooling will be 50°F DB ~ 115°F DB, and down to -4°F DB when optional wind baffle used and Jumper is cut on ODU.
- 3.03 The operating range in heating will be 5°F WB ~ 65°F WB.
- 3.04 The system shall be capable of maximum refrigerant piping as per schedule. The contractor shall submit equipment locations and refrigerant routing to manufacturer. Manufacturer shall verify and approve routing and refrigerant piping sizes.
- 3.05 Control points for mini-split systems accessible through BAS shall be as follows: on/off operation and monitoring, indoor unit malfunction notification, room temperature monitoring, set point setting and monitoring, operation mode setting and monitoring, remote-control permit/prohibit setting and monitoring.
- 3.06 Provide control panel to link all mini-split systems. Provide BACnet gateway with control panel.
- 3.07 Sequence of Operations: Space thermostat shall engage/disengage fan and equipment d/x stages of cooling and heating to maintain space temperature. Fan shall be constant volume.

### PART 4 – PRODUCTS

#### 4.01 INDOOR UNIT COMMON FEATURES

##### General:

All indoor units shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. Both liquid and suction lines must be individually insulated between the outdoor and indoor units.

##### A. Cabinet

- 1. Exposed cabinets shall be factory primed and finished with baked enamel with insulation on interior surfaces. Hidden cabinets shall be galvanized steel.
- 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- 3. Provide removable access panels where required for service.

##### B. Fan:

- 1. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single ECM motor.
- 2. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.
- 3. The indoor fan shall offer a choice of three speeds.

4. The fan shall have a delayed start when initially put into HEAT operation, giving time for the evaporator coil to heat up and preventing a cold draft from entering the room.
- C. Coil:
  1. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.
  2. All tube joints shall be brazed with silver alloy or phos copper.
  3. All coils will be factory pressure tested.
  4. A condensate pan shall be provided under the coil with a drain connection and lift mechanism. The lift mechanism provides up to 24-13/16" of lift, measured from the drain outlet.
  5. 2000 pulse electric expansion valve.
  6. Provide insulated drain pan.
- D. Filter:
  1. The unit shall be equipped with a bottom access washable filter panel.
- E. Electrical:
  1. Provide units at scheduled voltages. Units shall be capable of operating at  $\pm$  10% of rated voltage.
  2. Where scheduled as such, the indoor unit power shall be provided through the outdoor unit.
- F. Control:
  1. The unit shall have a hard wired remote controller with central controller interface for common control head end.
  2. The unit shall be compatible with interfacing with a BMS system via or BACnet gateway. Gateway not required for systems equipped with head end controller equipped with BACnet gateway for connection to BMS.
  3. The controller shall be able to display two-digit fault codes extracted from the indoor unit to aid in troubleshooting.
  4. The indoor unit microprocessor has the capability to receive and process commands via return air temperature and indoor coil temperature sensors enabled by commands from the remote controller.
  5. The unit shall have auto-restart after power failure.
- G. Sound:
  1. The indoor unit shall have a maximum radiated sound level of 40 dBA.
- H. Accessories:
  1. Condensate pump.
  2. Remote wall mounted thermostat.
  3. Mounting hardware.

#### 4.02 INDOOR WALL HUNG UNIT

- A. Unit Cabinet:
  1. The indoor unit shall have a white, "wipe-clean" finish.
  2. The drain and refrigerant piping shall be accessible from six (6) positions for flexible installation (right side, right back, and right bottom; and left side, left back, and left bottom).
  3. The cabinet shall be supplied with a mounting plate to be installed onto a wall for securely mounting the cabinet.
- B. Fan:

5. The evaporator fan shall be an assembly consisting of a direct-driven fan by a single motor.
  6. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings.
  7. An auto-swing louver for adjustable air flow (vertically).
  8. The indoor fan shall offer a choice of five speeds, plus quiet and auto settings.
  9. The fan shall have a delayed start when initially put into HEAT operation, giving time for the evaporator coil to heat up and preventing a cold draft from entering the room.
- C. Filter:
- a. The return air filter provided will be a mildew resistant, removable and washable filter. Two titanium apatite photocatalytic air purifying filters are included for additional air filtration.
- D. Coil:
- a. The evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger.
  - b. All tube joints shall be brazed with silver alloy or phoscopper.
  - c. All coils will be factory pressure tested.
  - d. A condensate pan shall be provided under the coil with a drain connection.

#### 4.03 INDOOR, CONCEALED FAN COIL UNIT

- A. Indoor Unit:
1. The unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall be equipment with automatically adjusting external static pressure logic that is selectable during commissioning. This adjusts the airflow based on the installed external static pressure.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be insulated from the outdoor unit.
  4. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 18-3/8" of lift from the center of the drain outlet and has a built in safety shutoff and alarm.
  5. The indoor units shall be equipped with a return air thermistor.
- B. Unit Cabinet:
1. The cabinet shall be located into the ceiling and ducted to the supply and return openings.
  2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
- C. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
  2. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
  3. The airflow rate shall be available in three settings.

4. The fan motor shall be thermally protected.
  5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
  6. Fan motor external static pressure range for nominal airflow:
- D. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
  3. The coil shall be a 3 row cross fin copper evaporator coil with 15 fpi design completely factory tested.
  4. The refrigerant connections shall be flare connections and the condensate will be 1-1/4" outside diameter PVC.
  5. A condensate pan shall be located under the coil.
  6. A condensate pump with an 18-3/8" lift shall be located below the coil in the condensate pan with a built in safety alarm.
  7. A thermistor will be located on the liquid and gas line.

#### 4.04 INDOOR AIR HANDLING UNIT

- A. Indoor Unit:
1. The unit components shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, brazed connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
  2. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
  3. Both refrigerant lines shall be insulated from the outdoor unit.
  4. Return air shall be through an optional or field supplied filter.
  5. Condensate draining shall be made via gravity or external condensate pump.
- B. Unit Cabinet:
1. The cabinet shall be constructed with sound absorbing, foil-faced insulation to control air leakage.
  2. Select an installation location with adequate structural support, space for service access and clearance for air return and supply duct connections.
  3. A field supplied secondary drain pan shall be installed where required by national, state, or local code.
- C. Fan:
1. The fan shall be a direct-drive Sirocco type fan, statically and dynamically balanced impeller with high and low fan speeds available.
  2. The airflow rate shall be available in high setting.
  3. The fan motor shall be thermally protected.
- D. Filter:
1. The return air shall be filtered by means of an optional or field supplied filter.
- E. Coil:
1. Coils shall be of the direct expansion type constructed from aluminum tubes expanded into aluminum fins to form a mechanical bond.

2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coils shall be a 2- to 4-row cross fin copper evaporator coil with 14 to 16 fpi design completely factory tested.
4. The refrigerant connections shall be brazed connections and the condensate will be 3/4 inch outside diameter PVC.
5. A thermistor will be located on the liquid and gas line.

#### 4.05 OUTDOOR UNIT

- A. General: The outdoor unit shall be specifically matched to the corresponding indoor unit size. The outdoor unit shall be complete factory assembled and pre-wired with all necessary electronic and refrigerant controls. The outdoor shall be controlled by a microprocessor and dedicated EEV's shall be provided for capacity control during part load of the indoor unit. The outdoor unit shall be wired and piped from either the front, lateral, or downward directions, accessed from the side of the unit. The system will automatically restart operation after power failure and will not cause any settings to be lost. High pressure switch, outdoor fan driver overload protector, inverter overload protector, fusible plugs, and fuses shall be provided.
- B. Unit Cabinet:
  1. The outdoor unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.
  2. The outdoor unit will come furnished with four (4) mounting feet, mounted across the base pan, to allow bolting to a cement pad or optionally supplied mounting bracket.
- C. Fan:
  1. The fan shall be a direct drive, propeller type fan.
  2. The motor shall be inverter driven, permanently lubricated type bearings, inherent.
  3. A fan guard is provided on the outdoor unit to prevent contact with fan operation.
  4. Unit airflow shall be as scheduled per make/model indicated, horizontal or upblast. See mechanical schedules for details.
- D. Condenser Coil:
  1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
  2. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film type E1, rated for up to 1000 hours salt spray.
  3. Refrigerant flow from the condenser will be controlled via a metering device.
  4. Automatic defrost will remove any frost from the outdoor unit allowing the system to maintain heating capacity.
  5. The pipe plates shall be treated with powdered polyester resin for corrosion prevention. The thickness of the coating must be between 2.0-3.0 microns.
- E. Compressor:
  1. The compressor shall be variable speed controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.



2. The inverter driven compressor shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed swing type.
  3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
  4. The compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
  5. The compressor shall be mounted to avoid the transmission of vibration.
- F. Electrical:
1. Provide units at scheduled voltages. Units shall be capable of operating at  $\pm$  10% of rated voltage.
  2. Where scheduled as such, the indoor unit power shall be provided through the outdoor unit.
- G. Sound:
1. Outdoor unit sound levels shall not exceed 65 dBA measured approximately 3 feet away with JIS standard operating conditions.
- H. Accessories:
1. Power monitor with auto-restart to disable unit when voltage falls outside of acceptable range. Can be factory or field provided.

END OF SECTION



## SECTION 239126 - PACKAGED ROOFTOP AIR-CONDITIONERS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. This section includes units with integral heating and cooling for outdoor installation. Integral heat source shall be heat pump with supplemental electric heat. Integral cooling source shall be packaged DX. Airflow arrangement shall be Outdoor Air with Recirculation. Each unit shall be constructed in a horizontal configuration with bottom supply and return duct connections and shall incorporate additional product requirements as listed in Section 2 of this specification.

#### 1.2 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AMCA 99—Standards Handbook
- C. AMCA 210—Laboratory Methods of Testing Fans for Rating Purposes
- D. AMCA 500—Test Methods for Louver, Dampers, and Shutters.
- E. AHRI 340/360 - Unitary Large Equipment
- F. NEMA MG1—Motors and Generators
- G. National Electrical Code.
- H. NFPA 70—National Fire Protection Agency.
- I. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
- J. UL 900—Test Performance of Air Filter Units.

#### 1.3 SUBMITTALS

- A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.
- B. Product Data:
  - 1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, and electrical characteristics and connection requirements.
  - 2. Provide computer generated fan curves with specified operating point clearly plotted.

3. Provide Protocol Implementation Conformance Statement (PICS)
  - a. Identifies all the portions of BACnet that are implemented.
  - b. PICS to list points on the graphics which are:
    - 1) Readable - monitoring only;
    - 2) Writable - can make adjustment such as enable, set-points, etc.
4. Manufacturer's Installation Instructions.

#### 1.4 OPERATION AND MAINTENANCE DATA

- A. Maintenance Data: Provide instructions for installation, maintenance and service.
- B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Filters: One set(s) for each unit.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.
- B. Startup must be done by trained personnel experienced with rooftop equipment.
- C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site.
- B. Accept products on site and inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

#### 1.7 WARRANTY

- A. Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period. Warranty shall be comprehensive including materials, labor, and any other ancillary costs.
  1. Warranty Period for Rooftop-Air-Handling Units: Three years from date of Substantial Completion.
  2. Warranty Period for Compressors: Five years from date of Substantial Completion.
  3. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Trane.
  2. York.
  3. Carrier.
  4. Daikin

### 2.2 GENERAL DESCRIPTION

- A. Furnish as shown on plans single zone heating and cooling units. Unit performance and electrical characteristics shall be per the job schedule.
- B. Configuration: Fabricate as detailed on prints and drawings:
1. Return plenum / economizer section
  2. Filter section
  3. Cooling coil section
  4. Supply fan section
  5. Condensing unit section
- C. The complete unit shall be cETLus listed.
- D. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 refrigerant and oil.
- E. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
- F. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
- G. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.
- H. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.

### 2.3 CABINET, CASING, AND FRAME

- A. Panel construction shall be double-wall construction for all panels (including floor panels). All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
- B. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16" at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.
- C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system with handle operator. Removable service panels secured by multiple mechanical fasteners are not acceptable.
- D. The unit base shall overhang the roof support structure for positive water runoff and shall seat on the structure with full perimeter isolator pad mounts installed between the unit base rail and structure. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

#### 2.4 OUTDOOR AIR DAMPER SECTION

- A. Unit shall be provided with a 0~30% outdoor air damper and mixing section. The outdoor air hood shall be factory installed and constructed from the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The damper blades shall be gasketed with side seals to provide an air leakage rate of 4 cfm/square foot of damper area at 1" differential pressure per ASHRAE 90.1 Energy Standard. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. The unit controller shall be capable of resetting the minimum damper position.

#### 2.5 OUTDOOR/RETURN AIR SECTION

- A. Unit shall be provided with a 0-30% Outside Air Damper. This section shall include an outside air damper. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1" differential pressure in according with testing defined in AMCA 500. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the 2 position, spring return type.

## 2.6 FILTERS

- A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

## 2.7 COOLING COIL

- A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
- B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
- C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
- D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
- E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.
- F. A drain pan over flow safety shall shut off the unit and issue a warning before over flow occurs.
- G. Exterior condensate drain piping shall be solid-wall schedule 40 PVC, ASTM D 2665, drain pipe. Grade all piping from unit drain connection to roof drain termination. Support piping at 4' on center in accordance with project drawings. Insulate drain piping with 3/4" thick flexible elastomeric insulation and wrap with 20-mil thick UV-resistant PVC protective covering.

## 2.8 HOT GAS REHEAT

- A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

- B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
- C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
- D. Each coil shall be factory leak tested with high-pressure air under water.

## 2.9 SUPPLY FAN

- A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
- B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
- C. Supply fan and motor assembly shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.
- D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
- E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

## 2.10 VARIABLE AIR VOLUME CONTROL

- A. The unit controller shall proportional control the ECM motors on the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with the compressor modulation.

## 2.11 ELECTRIC-RESISTANCE HEATING COILS: COMPLY WITH UL 1995

- A. Casing Assembly: Slip-in type with galvanized-steel frame.



- B. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
- C. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
- D. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- E. Control Panel: Unit mounted with disconnecting means and overcurrent protection.
  - 1) Magnetic contactor.
  - 2) Solid-state, stepless pulse controller.
  - 3) Toggle switches, one per step.
  - 4) Time-delay relay.
  - 5) Pilot lights, one per step.
  - 6) Airflow proving switch.

## 2.12 CONDENSING SECTION

- A. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
- B. Outdoor air coils shall be protected from incidental contact to coil fins by a coil guard. Coil guard shall be constructed of cross wire welded steel with PVC coating.
- C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25° F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
- D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.
- E. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.
- F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- G. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there

is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

- H. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

## 2.13 ELECTRICAL

- A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.
- B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

## 2.14 CONTROLS

- A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, dehumidification, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested. Equipment to be provided with BACnet over MSTP communication with a baud rate of 76.8.
- B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand-alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
- C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

- D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.
- E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
- F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
  - 1. Return air temperature.
  - 2. Cooling Coil discharge air temperature.
  - 3. Unit discharge air temperature.
  - 4. Outdoor air temperature.
  - 5. Space air temperature.
  - 6. Space air humidity.
  - 7. Outdoor enthalpy, high/low.
  - 8. Compressor suction temperature and pressure
  - 9. Compressor head pressure and temperature
  - 10. Expansion valve position
  - 11. Condenser fan speed
  - 12. Inverter compressor speed
  - 13. Dirty filter indication.
  - 14. Airflow verification.
  - 15. Cooling status.
  - 16. Control temperature (Changeover).
  - 17. Cooling status/capacity.
  - 18. Unit status.
  - 19. All time schedules.
  - 20. Active alarms with time and date.
  - 21. Previous alarms with time and date.
  - 22. Optimal start
  - 23. Supply fan speed.
  - 24. System operating hours.
    - a. Supply Fan
    - b. Cooling
    - c. Individual compressor
    - d. Heating
    - e. Economizer
    - f. Tenant override
    - g. Dehumidification
- G. The user interaction with the keypad shall provide the following:
  - 1. Controls mode
    - a. Off manual
    - b. Auto Heat/Cool/Dehumidification
    - c. Cool only

- d. Heat only
  - e. Dehumidification only
  - f. Fan only
  2. Occupancy mode
    - a. Auto
    - b. Occupied
    - c. Unoccupied
    - d. Tenant override
  3. Unit operation changeover control
    - a. Return air temperature
    - b. Space temperature
    - c. Space humidity
    - d. Network signal
  4. Cooling and heating change-over temperature with deadband
  5. Cooling discharge air temperature (DAT)
  6. Supply reset options
    - a. Return air temperature
    - b. Outdoor air temperature
    - c. Space temperature
    - d. Space humidity
    - e. Airflow (VAV)
    - f. Network signal
    - g. External (0-10 vdc)
    - h. External (0-20 mA)
  7. Temperature alarm limits
    - a. High supply air temperature
    - b. Low supply air temperature
    - c. High return air temperature
    - d. High space humidity
  8. Lockout control for compressors.
  9. Compressor interstage timers
  10. Night setback and setup space temperature.
  11. Economizer changeover
    - a. Enthalpy
    - b. Drybulb temperature
  12. Current time and date
  13. Tenant override time
  14. Occupied/unoccupied time schedule
  15. One event schedule
  16. Holiday dates and duration
  17. Adjustable set points
  18. Service mode
    - a. Timers normal (all time delays normal)
    - b. Timers fast (all time delays 20 sec)
- H. The unit is to be programmed with a night setback or setup function with space sensor to enable setback function. Space sensors shall be available to support field selectable features. Sensor options shall include:
1. Zone sensor with tenant override switch
  2. Zone sensor with tenant override switch plus heating and cooling set point adjustment.  
(Space Comfort Control systems only)

- I. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
  1. Airflow
  2. Outside air temperature
  3. Space temperature
  4. Space humidity
  5. Return air temperature
  6. External signal of 1-5 vdc
  7. External signal of 0-20 mA
  8. Network signal

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Unit Support: Install unit level on structural support. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of supports with actual equipment provided. Provide 1/2" thick continuous neoprene vibration isolation pad mount between unit base rail and top of structural support.
- B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.
- C. Install filter-gauge, static-pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum in accessible position. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.
- D. Connect duct to units with flexible connections. Comply with requirements in Division 15 section "Duct Accessories."
- E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.
- F. Install separate devices furnished by manufacturer and not factory installed.

- G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- H. Exterior condensate drain piping shall be solid-wall schedule 40 PVC, ASTM D 2665, drain pipe. Grade all piping from unit drain connection to roof drain termination. Support piping at 4' on center in accordance with project drawings. Insulate drain piping with  $\frac{3}{4}$ " thick flexible elastomeric insulation and wrap with 20-mil thick UV-resistant PVC protective covering.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to units, allow space for service and maintenance. Connect piping to units mounted on vibration isolators with flexible connectors.
- C. Duct Connections:
  - 1. Comply with requirements in Division 15 section "Metal Ducts."
  - 2. Drawings indicate the general arrangement of ducts.
  - 3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Division 15 section "Duct Accessories."

### 3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring and ground equipment in accordance with Division 16 requirements.
- B. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- C. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
  - 1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Division 16 requirements.
- C. MAC address and Device instance will be provided by JP Schools System integrator for input by equipment supplier.

### 3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks in accordance with manufacturer's written instructions.

2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
  3. Start refrigeration system when outdoor-air temperature is within normal operating limits, and measure and record the following:
    - a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    - b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    - c. Condenser coil entering-air dry-bulb temperature.
    - d. Condenser coil leaving-air dry-bulb temperature.
  4. Simulate maximum cooling demand and inspect the following:
    - a. Compressor refrigerant suction and hot-gas pressures.
    - b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
  5. Inspect casing insulation for integrity, moisture content, and adhesion.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Clean coils and inspect for construction debris.
  10. Inspect and adjust vibration isolators.
  11. Verify bearing lubrication.
  12. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  13. Start unit.
  14. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
  15. Operate unit for run-in period.
  16. Calibrate controls.
  17. Adjust and inspect high-temperature limits.
  18. Inspect outdoor-air dampers for proper stroke.
  19. Verify operational sequence of controls.
- B. After startup, change filters, and verify bearing lubrication.
- C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.
- D. Prepare written report of the results of startup services.
- 3.7 ADJUSTING
- A. Adjust initial temperature and humidity set points.
  - B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- 3.8 FIELD QUALITY CONTROL
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

3.9 DEMONSTRATION

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

END OF SECTION



## SECTION 260010 - ELECTRICAL GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.1 SCOPE

- A. This specification is for electrical and related work particular to St Augustine High School Wellness Center Renovation. Coordinate with other plans and specifications sections.

#### 1.2 RELATED DOCUMENTS

- A. The general provisions of the Contract, including Contract Requirements, and other Division 1 Specification sections, apply to this Section. Sections included in DIVISION 26 of the Project Manual are as follows:

SECTION 260010 - ELECTRICAL GENERAL PROVISIONS  
SECTION 260020 - BASIC ELECTRICAL MATERIALS AND METHODS  
SECTION 260519 - LOW VOLTAGE POWER CONDUCTORS AND CABLES  
SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS  
SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS  
SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS  
SECTION 26573.13 - SHORT-CIRCUIT STUDIES  
SECTION 26573.16 – COORDINATION STUDIES  
SECTION 26573.19 – ARC-FLASH HAZARD ANALYSIS  
SECTION 260923 - LIGHTING CONTROL DEVICES  
SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS  
SECTION 262416 - PANELBOARDS  
SECTION 262726 - WIRING DEVICES  
SECTION 262813 - FUSES  
SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS  
SECTION 265100 - INTERIOR LIGHTING  
SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS  
SECTION 271300- COMMUNICATIONS BACKBONE CABLING  
SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING  
SECTION 283111 – DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

#### 1.3 DESCRIPTION OF WORK

- A. This Section specifies several categories of provisions for electrical work, including: (1) Certain adaptive expansions of requirements specified in DIVISION 1, (2) General performance requirements within the electrical systems, and (3) General work to be performed as electrical work because of its close association.
- B. This Project Manual and accompanying Drawings are intended to describe complete workable systems of the various types. Items of materials, work, or equipment not mentioned but

normally necessary for the proper execution of this work, shall be provided as if specifically called for, at no additional cost to the Owner.

#### 1.4 SUMMARY OF ELECTRICAL WORK

##### A. Drawings:

1. Refer to the Electrical Drawings for graphic representations, schedules and notations showing electrical work.
2. The Drawings show approximate locations only of feeders, branch circuits, outlets, etc., except where specific routing or dimensions are indicated. The Architect reserves the right to make reasonable changes in locations indicated before roughing-in without additional cost to the Owner.
3. Because of the small scale of the Drawings, it is not possible to indicate all of the offsets, fittings, and accessories required. The Contractor shall investigate the structural and finish conditions affecting his work and shall arrange such work accordingly, furnishing fittings, bends, junction boxes, pull boxes, access panels, and accessories required to meet such conditions.

##### B. Project Manual:

1. Refer to the DIVISION 26 Sections for the primary technical Sections of electrical work.
2. General Outline: This section of the Project Manual covers furnishing materials, equipment, constant competent supervision, special tools, test equipment, technicians, and labor necessary for installation of a complete working electrical system, all as indicated on the plans of in this Project Manual.

##### C. Scope: Under this part of the contract, electrical facilities will be constructed at St Augustine High School Wellness Center at 2600 Tureaud Av, New Orleans, LA 70119. A new electrical service will be established. Coordinate with Entergy to bring new 2000 amp, 208Y/120 volt, three phase, 4 wire, overhead service to building.

1. Alternates for construction are specified to accommodate work which may or may not be part of the construction contract.
2. Phasing of the project is critical. The existing building will be operating to full capacity throughout the construction period.
3. The work shall include but not necessarily be limited to the following:
  - a. Power distribution systems - feeder & branch circuits, panels, wiring, transformers, devices, etc.
  - b. Installation of motors which are not an integral part of equipment furnished under other Divisions.
  - c. Power wiring and connections of mechanical equipment.
  - d. Service systems.
  - e. Grounding systems.
  - f. Raceway systems.
  - g. Lighting systems-fixtures/lamps/auxiliaries wiring/connections/etc.
  - h. Emergency power and lighting systems.
  - i. Fire alarm system.
  - j. Lighting control systems.
  - k. All required sleeves, thimbles, anchors, hangers, bolts, miscellaneous structural steel, cutting, etc., for the complete installation of the electrical systems serving the building.
  - l. Temporary electrical services for construction.

## 1.5 COORDINATION OF ELECTRICAL WORK

- A. General: Refer to the DIVISION 1 sections for general coordination requirements applicable to the entire work. It is recognized that the contract documents are diagrammatic in showing certain physical relationships which must be established within the electrical work, and in its interface with other work including utilities and mechanical work, and that such establishment is the exclusive responsibility of the Contractor.
- B. Arrange electrical work in a neat, well-organized manner with exposed conduit and similar services running parallel with primary lines of the building construction, and with a minimum of 8'-0" overhead clearance or as directed by the Architect.
- C. Advise other trades of openings required in their work for the subsequent move-in of large units of electrical work (equipment).
- D. Verify final locations for rough ins with field measurements and with the requirements of the actual equipment to be connected.
- E. Refer to equipment Sections in Divisions 2 through 23 for rough-in requirements.
- F. Verify all dimensions by field measurements.
- G. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
- H. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- I. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- J. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
- K. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.
- L. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- M. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- N. Coordinate connection of electrical systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- O. Coordinate with owner when replacing existing electrical service and equipment at gym. The existing gym switchboard serves the classroom science building. This work must be done when school is not in session.

#### 1.6 TEMPORARY ELECTRICITY

- A. Furnish and install all necessary temporary power, metering, lighting or wiring that is required to ensure quality workmanship everywhere.
- B. Furnish and install area distribution boxes with ground fault protection so located that the individual trades may use their own construction-type extension cords to obtain proper power and artificial lighting at all points where required by inspectors and for safety.

#### 1.7 QUALITY ASSURANCE, STANDARDS

- A. General: In addition to standards specified in individual work sections, the following standards are imposed, as applicable to the work in each instance:
  - 1. NFPA 70, National Electrical Code
    - a. The electrical installation shall conform to the requirements of the latest edition of the National Electrical Code (NEC-NFPA 70).
  - 2. NEMA/ANSI/ASTM
    - a. Electrical material shall be built and tested in accordance with the applicable standards of the National Electrical Manufacturer's Association (NEMA); the American National Standards Institute (ANSI); and the American Society of Testing and Materials (ASTM).
  - 3. Underwriters' Laboratories (UL)
    - a. Electrical materials shall be new and unused and shall be listed, inspected, approved and labeled by Underwriters' Laboratories, Inc., where such labeling service is available.
  - 4. NFPA-101, Life Safety Code
    - a. OSHA Code of Federal Regulations (for construction practices)
    - b. Applicable state and local codes/ordinances.
  - 5. International Building Code

#### 1.8 ELECTRICAL SUBMITTALS:

- A. Refer to Division 1 Section 01630 for submittal definitions, requirements, and procedures.
- B. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect will not be processed.

#### 1.9 SUBSTITUTIONS/PRIOR APPROVALS

- A. Substitutions/Prior Approvals shall be submitted in accordance with Section 01630 and provisions thereof.
- B. Only firms regularly engaged in the manufacture of electrical products of types required, whose products have been in satisfactory use in similar service for not less than 3 years, shall be utilized.

- C. Any item not specified herein but submitted for approval as a substitute for the specified item shall be accompanied by manufacturer's documentation stating/illustrating the following applicable information in addition to the specific information requested in other sections:
    - 1. Dimensions/weight.
    - 2. Electrical ratings-voltage, amperage, short circuit capability, etc.
    - 3. Construction - gauge of steel/aluminum, paint finish/application method, color, NEMA type, etc.
    - 4. Warranty.
    - 5. Local manufacturer's representative or nearest stocking distributor.
    - 6. Length of time the product has been available to the public.
  
  - D. Shop Drawings: Submit completion descriptive and dimensional data on the following materials which Contractor proposes to use:
    - 1. Panelboards
    - 2. Lighting Fixtures
    - 3. Fuses
    - 4. Safety Switches
    - 5. Circuit Breakers
    - 6. Wiring Devices
    - 7. Lighting Controls
    - 8. Conductors
    - 9. Communication cabling
    - 10. Fire Alarm System
    - 11. Fire Stop Materials
  
  - E. Corrections or comments made on shop drawings during the review do not relieve the Contractor from compliance with requirements of the Contract Documents, Plans and Project Manual. Shop Drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the contract documents. Review of Shop Drawings shall not relieve the Contractor from responsibility for confirming and correlating all quantities and dimensions, coordinating work with that of all other trades, and performing work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviation from Plans and Project Manual. Shop Drawings must be accompanied by signed statement from contractor, stating that he has reviewed the submittal and checked it for compliance.
  
  - F. See Section 01330, for number of copies of shop drawings and product data to be submitted.
- 1.10 DELIVERY, STORAGE AND HANDLING:
- A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications, adequately packaged and protected to prevent damage during shipment, storage, and handling.
  
  - B. Store equipment and materials at the site unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
  
  - C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion.

1.11 RECORD DOCUMENTS:

- A. Refer to Division 1 Section 01781 for requirements.

1.12 OPERATION AND MAINTENANCE DATA:

- A. Refer to Division 1 Section 01782 for procedures and requirements for preparation and submittal of maintenance manuals.

1.13 WARRANTIES:

- A. Refer to Division 1 Section 01770 for procedures and submittal requirements for warranties. Refer to individual equipment Sections for warranty requirements.

1.14 CLEANING

- A. Refer to Division 1 Section 01770 for general requirements for final cleaning.
- B. Clean and restore to original finish all equipment prior to final acceptance.

1.15 GUARANTEE:

- A. The work installed shall be kept in perfect working order for one year from date of substantial completion. Guarantee shall be based upon defective materials and/or workmanship. Furnish free of cost to the Owner materials and labor necessary to comply with this guarantee.

1.16 WIRING FOR EQUIPMENT BY OTHERS:

- A. Electrical service for all equipment furnished under this Project manual shall be roughed-in and connected under this Section. It is the responsibility of the Contractor to obtain correct roughing-in dimensions and requirements for this equipment.
- B. Under other DIVISIONS, unless otherwise noted, equipment will be furnished such as: motors and magnetic motor starters (except when part of motor control centers). The connection/interconnection of that equipment shall be part of DIVISION 260000 and shall comply with other DIVISION 260000 Basic Material and Methods Sections.
- C. Apparatus required for controls and firestats will be furnished as specified under DIVISION -23 Mechanical Work. Control wiring shall be furnished and installed as work under DIVISION 23 - Mechanical.

1.17 TESTS AND BALANCING

- A. The contractor shall conduct operating tests to demonstrate that the electrical systems are installed and will operate properly and in accordance with the requirements of this Project

Manual. Tests shall be performed in the presence of the Architect's representative. The Contractor shall furnish instruments and personnel required for such tests.

- B. The contractor shall perform tests in the presence of the Architect to show that the power and lighting loads are equally divided among phases of feeders serving each piece of equipment and each panelboard.
- C. Any work and materials tested and found varying from the requirements of the Drawings and Project Manual shall be replaced by the Contractor without additional cost to the Owner.
- D. This requirement is in addition to specific tests such as high-potential tests, meggar test, phasing tests, generator testing, etc. which may be called for in other sections.

#### 1.18 WORKMANSHIP

- A. Install all materials and electrical components of the work in accordance with instructions of manufacturer following the best modern construction practices and conforming with the Contract Documents. Workmanship shall be first class, in both function and appearance, whether finally concealed or exposed and shall be performed by experienced workmen skilled in the type of work. As practicable, the lines of all components of the system shall be perpendicular or parallel. In general, workmanship shall conform to guidelines set forth in N.E.C.A. manuals.

#### 1.19 MOUNTING HEIGHTS:

- A. Unless otherwise noted on the Drawings or required by the Architect, the following mounting heights shall apply.
- B. Upon approval of the Architect, mounting heights may be adjusted.
- C. Heights of Outlets - all heights measured from finish floor to bottom of device.
  - 1. Wall Switches 44"
  - 2. Receptacle Outlet 18" or above base flood elevation
  - 3. Special Purpose Outlet within 12" (12 inches) of intended use
  - 4. Communications Outlet 18" or above base flood elevation
  - 5. Fire Alarm Station 44"
  - 6. Fire Alarm Annunciator 80"(per ADA Requirements)
  - 7. Wall Mounted PIR 44"  
Occupancy Sensors
- D. Heights of Disconnect Switches, Protective Devices, Controllers, etc.
- E. The mounting height of disconnect switches, circuit breakers, motor controllers, push button stations, and other similar devices and equipment will vary depending upon location and whether individually or group mounted. For convenience and safety operating levers, handles or buttons shall be mounted no more than 80 inches above the finish floor line.
- F. Panelboards shall be located so that the highest overcurrent protective device is a maximum of 72" above the floor.

1.20 SAFETY

- A. It shall be the Contractor's responsibility to do all things necessary in the pursuit of the installation or testing to provide safe conditions in which to work.

1.21 FIRESTOPPING

- A. Firestopping of all openings in fire-rated floors, walls, and ceilings accommodating penetrating items such as cables, bus ducts, wireways, conduits, etc. shall be required as part of DIVISION 26000 work. Provide Firestop installation as required to meet ratings equal to the floor or wall being penetrated.
- B. Fire stop materials shall be manufactured for that purpose and shall be installed in accordance with the manufacturer's recommendation in order to provide a U.L. listed fire stop at all openings equal to or exceeding the rated floor, wall or ceiling.
- C. Plastic sleeves/pipe shall not be used within the building when penetrating a fire-resistant-rated wall, ceiling, partition, or floor.

1.22 POWER SYSTEM STUDY:

- A. Provide a power system analysis only as necessary for the following. A report is required to be submitted for review. See sections 260573.13 Short Circuit Study, 260573.16 Coordination Studies, and 260573.19 Arc Flash Analysis for more information.
  - 1. To determine the arc-flash hazard and label equipment appropriately, in accordance with NEC 110.16.
  - 2. To verify specified equipment short circuit ratings, exceed available fault currents.
  - 3. Note the power system study is needed at the same time as the gear submittal is submitted. If the gear submittal is needed before the study is available, then the contractor will be responsible for any recommended changes in equipment or devices shown in the report.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION



## SECTION 260020 - BASIC ELECTRICAL MATERIALS & 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. Supporting devices for electrical components.
  - 2. Electricity-metering components.
  - 3. Concrete equipment bases.
  - 4. Cutting and patching for electrical construction.
  - 5. Touchup painting.
  - 6. Access to Electrical Work:
    - a. Access doors in walls, ceilings, and floors.
    - b. Removable cover plates in walls, ceilings, and floors.
  - 7. Excavating, Trenching and Backfill for Electrical Work.

#### 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.

#### 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."

## PART 2 - PRODUCTS

### 2.1 SUPPORTING DEVICES

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-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: Comply with Division 5 Section "Metal Fabrications" for slotted channel framing.
  - 1. Channel Thickness: Selected to suit structural loading.
  - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. 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.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

- 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: All-steel springhead type.
- J. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.2 MATERIALS OF CONCRETE WORK

- A. Light Pole Foundations and Concrete Bases:
  - 1. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section "Cast-in-Place Concrete."
  - 2. Concrete: 3000-psi, 28-day compressive strength as specified in Division 3 Section "Cast-in-Place Concrete."

## 2.3 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

## 2.4 ACCESS TO ELECTRICAL WORK

- A. General: Where switches, control devices pull boxes and similar elements of electrical work are located within or behind wall, ceiling or floor construction of finishes, or below grade, provide removable access plates of types and sizes needed for access requirements. Provide manufacturer's complete units with anchorages, fasteners and standard factory-applied finishes. Hinged access doors shall comply with Section 08305.

## 2.5 EXCAVATING FOR ELECTRICAL WORK

- A. Backfill Materials:
- B. Subbase Material: A graded mixture of gravel, sand, crushed stone or crushed slag.
- C. Backfill Material: Soil material suitable for compacting to required densities and complying with AASHTO Designation M 145. Group A-1, A-2-4, A-2-5, or A-3.
- D. Drainage Fill Material: Washed and uniformly graded gravel, crushed stone or crushed slab, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

## 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 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel 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.

### 3.3 SUPPORT INSTALLATION

- A. Install support devices to fasten and support electrical components securely and permanently.
- 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. For floors-on-grade, support all raceways under slab from stainless steel 1/2" rod every four (4) feet.
- H. 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.

- I. 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.
- J. Simultaneously install vertical conductor supports with conductors.
- K. 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.
- L. 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.
- M. 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.
- N. 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.

### 3.4 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."

### 3.5 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."

### 3.6 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Supporting devices for electrical components.
  - 2. Concrete bases.
  - 3. Electrical demolition.
  - 4. Cutting and patching for electrical construction.
  - 5. Touchup painting.
  - 6. Electricity-metering components.

### 3.8 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.

### 3.9 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.

### 3.10 EXCAVATION, TRENCHING & BACKFILLING

- A. Perform all excavation of every description and of whatever substances encountered to the depths indicated on the Drawings or as otherwise specified. During excavation, material

suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or not suitable for backfill shall be removed and wasted or removed from jobsite as indicated on the drawings or as directed by Architect, at no additional cost to Owner.

- B. Sheeting and shoring shall be done as necessary for the protection of the work and for the safety of personnel. Always provide necessary pumping to maintain a dry working condition in all trenches. Unless otherwise indicated, excavations shall be by open cut except that short sections of a trench may be tunneled if, in the opinion of the Architect, the conduit can be safely and properly installed and backfill can be properly tamped in such tunneled sections.
- C. No excavation or trenches shall be cut near or under footings without first consulting Architect.
- D. Bottom of trench shall be shaped to give substantially uniform circumferential support to lower third of each pipe. Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offset to flow line. As work progresses, interior of pipe shall be cleared of dirt and superfluous materials of every description.
- E. Wherever wet or otherwise unstable soil that is incapable of properly supporting the pipe, as determined by the Architect, is encountered in the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, fine gravel, or other suitable material, as approved by the Architect.
- F. Trenches for utilities shall be of a depth that will provide the following minimum depth of cover from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown:  
  
24-Inch Minimum Cover - Electrical Conduit under 600 volts.
- G. Backfill shall be installed in layers 6" deep, adequately wetted (if approved by Architect) and tamped using materials as noted above. The surfaces shall be graded to a reasonable uniformity and the mounting over trenches left in a uniform and neat condition as approved by the Architect.
- H. Restore all hard finished surfaces such as roadway, sidewalks, grass, shrubbery, etc., removed for installation of utilities (and not shown on Drawings or specified to be reworked under other sections of the work) to their original condition using the same type as original materials.
- I. Carefully plan all work to avoid existing utilities and other interferences. Architect has not attempted to indicate all existing underground utilities. Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling and, if damaged, shall be repaired by the Contractor at his expense. Prior to doing any excavation with power tools, carefully investigate and locate any existing conduit, pipes, and other lines, to avoid them during excavation.

END OF SECTION





## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### 1.3 DEFINITIONS

- A. VFC: Variable frequency controller.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. Alpha Wire.
  - 3. Belden Inc.
  - 4. Encore Wire Corporation.
  - 5. General Cable Technologies Corporation.
  - 6. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

## 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Gardner Bender.
  - 3. Hubbell Power Systems, Inc.
  - 4. Ideal Industries, Inc.
  - 5. IlSCO; a branch of Bardes Corporation.
  - 6. NSi Industries LLC.
  - 7. O-Z/Gedney; a brand of the EGS Electrical Group.
  - 8. 3M; Electrical Markets Division.
  - 9. Tyco Electronics.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.3 SYSTEM DESCRIPTION

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

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 1/0 AWG; copper or aluminum for feeders No. 1/0 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2 or XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2 or XHHW-2 single conductors in raceway

- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, or XHWN-2 single conductors in raceway
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2 or XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, or XHHW-2 single conductors in raceway .
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260020 "Basic Materials & Methods."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
  - 2. Splices shall be allowed in branch circuits. Splices in feeders shall only be allowed when specifically shown on plan.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - 2) Include recommended testing intervals.

## 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Burndy; Part of Hubbell Electrical Systems.
  - 2. Dossert; AFL Telecommunications LLC.
  - 3. ERICO International Corporation.
  - 4. Fushi Copperweld Inc.
  - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - 6. Harger Lightning and Grounding.
  - 7. ILSCO.
  - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
  - 9. Robbins Lightning, Inc.
  - 10. Siemens Power Transmission & Distribution, Inc.

### 2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

## 2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

## 2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- F. Metallic Fences: Comply with requirements of IEEE C2.
  - 1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
  - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
  - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service



- grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- H. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

### 3.6 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

#### 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
  2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
  2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
  4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
  2. Allied Tube & Conduit; a Tyco International Ltd. Co.
  3. Anamet Electrical, Inc.
  4. Electri-Flex Company.
  5. O-Z/Gedney; a brand of EGS Electrical Group.
  6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.

7. Republic Conduit.
  8. Southwire Company.
  9. Thomas & Betts Corporation.
  10. Western Tube and Conduit Corporation.
  11. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. ARC: Comply with ANSI C80.5 and UL 6A.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - a. Material: die cast.
    - b. Type: Setscrew.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
  2. Anamet Electrical, Inc.
  3. Arco Corporation.
  4. CANTEX Inc.
  5. CertainTeed Corp.
  6. Condux International, Inc.
  7. Electri-Flex Company.
  8. Kraloy.
  9. Lamson & Sessions; Carlon Electrical Products.
  10. Niedax-Kleinhuis USA, Inc.

11. RACO; a Hubbell company.
  12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - C. ENT: Comply with NEMA TC 13 and UL 1653.
  - D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
  - E. LFNC: Comply with UL 1660.
  - F. RTRC: Comply with UL 1684A and NEMA TC 14.
  - G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
  - H. Fittings for LFNC: Comply with UL 514B.
  - I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Cooper B-Line, Inc.
  2. Hoffman; a Pentair company.
  3. Mono-Systems, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
  1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Adalet.
  2. Cooper Technologies Company; Cooper Crouse-Hinds.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. FSR Inc.
  6. Hoffman; a Pentair company.
  7. Hubbell Incorporated; Killark Division.
  8. Kraloy.
  9. Milbank Manufacturing Co.
  10. Mono-Systems, Inc.
  11. O-Z/Gedney; a brand of EGS Electrical Group.
  12. RACO; a Hubbell Company.
  13. Robroy Industries.
  14. Spring City Electrical Manufacturing Company.
  15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
  16. Thomas & Betts Corporation.
  17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Gangable boxes are allowed.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC or IMC.
  3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  5. Damp or Wet Locations: GRC or IMC.
  6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
  3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass-through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).
- 3.2 INSTALLATION
- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.



- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.
- DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Identification for conductors.
  - 2. Underground-line warning tape.
  - 3. Warning labels and signs.
  - 4. Instruction signs.
  - 5. Equipment identification labels.
  - 6. Miscellaneous identification products.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

#### 1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

### 2.2 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE .
  - 3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.
- C. Tag: Type I :
  - 1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 2. Thickness: 4 mils.
  - 3. Weight: 18.5 lb/1000 sq. ft..
  - 4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

## 2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face .
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

## 2.6 CABLE TIES

- A. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one-piece, self-locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

## 2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the panel name and circuit number for the conductors in junction box.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.



- a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
  - b. Colors for 208/120-V Circuits:
    - 1) Phase A: Black.
    - 2) Phase B: Red.
    - 3) Phase C: Blue.
  - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer load shedding .
- J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  1. Labeling Instructions:
    - a. Indoor Equipment: Adhesive film label with clear protective overlay . Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label .
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Lighting Control Panels
    - f. Junction boxes and enclosures.
    - g. Fused Disconnect Switches – Provide panel and circuit number of source.
    - h. Receptacles

END OF SECTION

## SECTION 260573.13 - SHORT-CIRCUIT STUDIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

#### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

#### 1.4 ACTION SUBMITTALS

##### A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
  - a. Short-circuit study input data, including completed computer program input data sheets.
  - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
    - 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
    - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

#### 1.5 INFORMATIONAL SUBMITTALS

##### A. Qualification Data:

1. For Power System Analysis Specialist.

##### B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

#### 1.6 CLOSEOUT SUBMITTALS

##### A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
  - a. Final one-line diagram.
  - b. Final Short-Circuit Study Report.
  - c. Short-circuit study data files.
  - d. Power system data.

#### 1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

- C. Manual calculations are unacceptable.
  - 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
- D. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.

## PART 2 - PRODUCTS

### 2.1 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
  - 6. Derating factors and environmental conditions.
  - 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:

1. One-line diagram of system being studied.
2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Calculated asymmetrical fault currents:
    - 1) Based on fault-point X/R ratio.
    - 2) Based on calculated symmetrical value multiplied by 1.6.
    - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

### PART 3 - EXECUTION

#### 3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.

2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Data include, but are not limited to, the following:
1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance at the service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  7. Motor horsepower and NEMA MG 1 code letter designation.
  8. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  9. Derating factors.

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
  1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also

account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.
- J. The short circuit study should be completed and submitted before ordering electrical distribution equipment for the project, so that any adjustments to the rating for the equipment for this project can be adjusted to match the recommendations included in the report.

END OF SECTION



## SECTION 260573.16 - COORDINATION STUDIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - 1. Study results shall be used to determine coordination of fully-rated devices.
  - 2. Recommend device settings or electronic circuit breakers so that the emergency system is fully coordinated. The emergency system are the panels connected to ATS-EHS.

#### 1.3 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- C. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- D. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- E. SCCR: Short-circuit current rating.
- F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- G. Single-Line Diagram: See "One-Line Diagram."

#### 1.4 ACTION SUBMITTALS

- A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
  - a. Coordination-study input data, including completed computer program input data sheets.
  - b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
  - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  1. For Power System Analysis Software Developer.
  2. For Power Systems Analysis Specialist.
- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  1. The following are from the Coordination Study Report:
    - a. Final one-line diagram.
    - b. Final protective device coordination study.
    - c. Coordination study data files.
    - d. List of all protective device settings.
    - e. Time-current coordination curves.
    - f. Power system data.

#### 1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
  - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Comply with IEEE 242 and IEEE 399.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

### 2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:

1. Protective device designations and ampere ratings.
  2. Conductor types, sizes, and lengths.
  3. Transformer kilovolt ampere (kVA) and voltage ratings.
  4. Motor and generator designations and kVA ratings.
  5. Switchgear, switchboard, motor-control center, and panelboard designations.
  6. Any revisions to electrical equipment required by the study.
  7. Study Input Data: As described in "Power System Data" Article.
    - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
    - a. Phase and Ground Relays:
      - 1) Device tag.
      - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      - 3) Recommendations on improved relaying systems, if applicable.
    - b. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, and ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
  2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
  3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  4. Plot the following listed characteristic curves, as applicable:
    - a. Power utility's overcurrent protective device.
    - b. Medium-voltage equipment overcurrent relays.
    - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

- d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
  - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  - f. Cables and conductors damage curves.
  - g. Ground-fault protective devices.
  - h. Motor-starting characteristics and motor damage points.
  - i. Generator short-circuit decrement curve and generator damage point.
  - j. The largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
  6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
  7. Provide adequate time margins between device characteristics such that selective operation is achieved.
  8. Comments and recommendations for system improvements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
  1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

#### 3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
  1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
  1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Maximum demands from service meters.
12. Motor horsepower and NEMA MG 1 code letter designation.
13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
14. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
15. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
  - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  - 1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
  - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
  - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- K. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- L. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
  3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
  4. Include in the report identification of any protective device applied outside its capacity.
- M. Contractor shall submit coordination recommendations before electrical gear submittal is ordered so that any changes to the electrical gear and circuit breakers can be modified based upon the recommendations of this report.

### 3.4 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

### 3.5 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
  1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

END OF SECTION



## SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

#### 1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
  - 3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  - 1. For Power Systems Analysis Software Developer.
  - 2. For Power System Analysis Specialist.
  - 3. For Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
  - 1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
  - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

#### 1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
  - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
  - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
  - 2. A member company of NETA.
  - 3. Acceptable to authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.
  - 3. Duration of arc.
  - 4. Arc-flash boundary.
  - 5. Restricted approach boundary.
  - 6. Limited approach boundary.
  - 7. Working distance.
  - 8. Incident energy.
  - 9. Hazard risk category.
  - 10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

## 2.2 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
  - 1. Location designation.
  - 2. Nominal voltage.
  - 3. Protection boundaries.
    - a. Arc-flash boundary.
    - b. Restricted approach boundary.
    - c. Limited approach boundary.

4. Arc flash PPE category.
  5. Required minimum arc rating of PPE in Cal/cm squared.
  6. Available incident energy.
  7. Working distance.
  8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

#### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination study studies prior to starting the Arc-Flash Hazard Analysis.
1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
  2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
  2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
  3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
  4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
  - 1. Verify completeness of data supplied on one-line diagram on Drawing. Call discrepancies to Architect's attention.
  - 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
  - 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
  - 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Obtain electrical power utility impedance or available short circuit current at the service.
  - 3. Power sources and ties.
  - 4. Short-circuit current at each system bus (three phase and line to ground).
  - 5. Full-load current of all loads.
  - 6. Voltage level at each bus.

7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

#### 3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment [for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
  1. Motor-control center.
  2. Low voltage transformers
  3. Panelboard and safety switch over 250 V.
  4. Applicable panelboard and safety switch under 250 V.
  5. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
  1. Indicate arc-flash energy.
  2. Indicate protection level required.

#### 3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION



## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Indoor occupancy sensors.
- B. Related Requirements:
  - 1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 INDOOR OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Bryant Electric; a Hubbell company.
  - 2. Cooper Industries, Inc.
  - 3. Hubbell Building Automation, Inc.
  - 4. Leviton Mfg. Company Inc.

5. Lithonia Lighting; Acuity Lighting Group, Inc.
  6. Lutron Electronics Co., Inc.
  7. Sensor Switch, Inc.
  8. Legrand -Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  5. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Bryant Electric; a Hubbell company.
  2. Cooper Industries, Inc.
  3. Hubbell Building Automation, Inc.
  4. Leviton Mfg. Company Inc.
  5. Lithonia Lighting; Acuity Lighting Group, Inc.
  6. Lutron Electronics Co., Inc.
  7. Sensor Switch, Inc.
  8. Legrand -Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor Tag OS:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
  2. Sensing Technology: PIR.
  3. Switch Type: SP.
  4. Voltage: Dual voltage, 120 and 277 V; type.
  5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
  6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
  7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.

8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

## 2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
  1. Identify controlled circuits in lighting contactors.
  2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 3 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

### 3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
- B. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION



## SECTION 260943.23 - RELAY-BASED LIGHTING CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes: Lighting control panels using mechanically held relays for switching.
- B. Section Includes: Networked lighting control panels using control-voltage relays for switching and that are interoperable with BAS.

#### 1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. IP: Internet protocol.
- C. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- D. PC: Personal computer; sometimes plural as "PCs."
- E. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and plates, and conductors and cables.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each relay panel and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail wiring partition configuration, current, and voltage ratings.

4. Short-circuit current rating of relays.
5. Include diagrams for power, signal, and control wiring.
6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.
  1. Show interconnecting signal and control wiring, and interface devices that prove compatibility of inputs and outputs.
  2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the network protocol.
- B. Field quality-control reports.
- C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.
- D. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  1. Software operating and upgrade manuals.
  2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  3. Device address list.
  4. Printout of software application and graphic screens.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panels for installation according to NECA 407.



## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Input signal from field-mounted manual switches, or digital signal sources, shall open or close one or more lighting control relays in the lighting control panels. Any combination of inputs shall be programmable to any number of control relays.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with UL 916.

### 2.2 LIGHTING CONTROL RELAY PANELS

- A. Basis-of-Design Product: ILC: EVO Controller.

Description: Each controller shall be designed to be remotely installed and provide control of 4 remote load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.

1. Enclosure: Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with a 1/2" nipple and pre-drilled mounting holes.
2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
5. High Voltage Connections: Each controller shall be provided with 6" wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
6. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect connectors for occupancy sensors, and photo sensor inputs. All connections

shall be made to clearly and permanently labeled termination points.

7. **Occupancy Sensor Inputs:** It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 200mA w/4 LightSync devices connected to the controller
    - 160mA w/5 LightSync devices connected to the controller
    - 120mA w/6 LightSync devices connected to the controller
    - 90mA w/7 LightSync devices connected to the controller
    - 60mA w/8 LightSync devices connected to the controller
  8. **Photocell Inputs:** It shall provide 2 integrated interfaces for ILC photocell heads. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
  9. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 61 LightSync data line devices. It shall provide power for LightSync devices as described in #7 or additional power added with an optional Power Supply Repeater.
  10. **Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
  11. **Pre-Configured Programs:** Each controller shall have up to 16 selectable pre-configured lighting application programs and 1 default contractor program.
- B. **LightSync -EVO Room Controller:** Each controller shall be designed to be remotely installed and provide control of 4 load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.

1. Enclosure: Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with a 1/2" nipple and pre-drilled mounting holes.
2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC or optional 120/347 VAC primary (50 to 60 Hz). It shall contain an internal self-resetting fuse.
5. High Voltage Connections: Each controller shall be provided with 6" wire leads for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
6. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, and the relay connections. It shall also be provided push-to-connect connectors for occupancy sensors, and photo sensor inputs. All connections shall be made to clearly and permanently labeled termination points.
7. Occupancy Sensor Inputs: It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
  - 200mA w/4 LightSync devices connected to the controller
8. Photocell Inputs: It shall provide 2 integrated interfaces for ILC photocell heads. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
9. Local Data Line Port: It shall provide an RJ45 data line port for up to 4 LightSync data line devices. It shall provide power for LightSync devices as described in #7 or additional power added with an optional Power Supply Repeater.

- C. LightLEEDer EVO Integrated -4 -8 Relay Controller: Each controller shall be designed to be remotely installed and provide control of 4 or 8 integrated load control relays. This controller shall have the same features as the Programmable Lighting Control Panels excluding add-ons and naming.
1. Enclosure: Each controller shall be provided with a NEMA 1 galvanized steel enclosure with a removable screw cover. It shall also be provided with 1/2" knock-outs and pre-drilled mounting holes.
  2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
  3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
  4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
  5. Relay Ratings: It shall be provided with 4- or 8- 50A load relays that shall be derated for 16 amps for durability. It shall control 16A for each set of 4 outputs:
    - 16A, 120/277VAC Electronic Ballast (LED)
    - 16A 120/277VAC Tungsten
    - 1/4 HP @ 120 VAC Motor Load
  6. High Voltage Connections: Each controller shall be provided with terminal blocks for terminating the high voltage connections. All connections shall be made to clearly and permanently labeled termination points.
  7. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, and photo sensor connections. It shall also be provided push-to-connect and screw connectors for occupancy sensors, dimming, and low-voltage inputs. All connections shall be made to clearly and permanently labeled termination points.
  8. Occupancy Sensor Inputs: It shall have 4 independent inputs, and each input shall be able to interface multiple occupancy sensors or hardwired switches. Each input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 60mA w/4 LightSync devices connected to the controller
    - 50mA w/5 LightSync devices connected to the controller
    - 40mA w/6 LightSync devices connected to the controller

- 20mA w/7 LightSync devices connected to the controller
  - 0mA w/8 LightSync devices connected to the controller
- 9. Photocell Inputs:** It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
- 10. Local Data Line Port:** It shall provide an RJ45 data line port for up to 17 LightSync data line devices. It shall provide power for LightSync devices as described in #8 or additional power added with an optional Power Supply Repeater.
- 11. Dimming:** It shall be provided with 4 or 8 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
- 12. Real-Time Clock:** Each controller shall be provided with a Real-Time Clock used to perform all time-controlled functions. It shall use a high-voltage line-sync circuit for timing and a crystal for backup. Clock accuracy shall be held +/- 2 minutes per year and displayed to the second with the line-sync setting. Real-Time Clock functions shall include the time of day, day of the week, date, and automatic daylight-saving time and leap year adjustments. The time clock shall be protected against loss of time during a power outage for a period of up to 45 days without power of any type. Daylight Saving Time shall be adjustable with an enable/disable feature. Systems relying on a single clock device shall not be acceptable.
- 13. Pre-Configured Programs:** Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.
- D. LightLEEDer EVO Integrated 2 Relay Controller:** Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.
- 1. Enclosure:** Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½” nipple and mounting tab.
  - 1. Plenum Rated:** Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
  - 2. Listing:** Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.

3. **Controller Power Supply:** Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
4. **Relay Ratings:** It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
  - 16A, 120/277VAC Electronic Ballast (LED)
  - 20A 120/277VAC General
  - 1/4 HP @ 120 VAC Motor Load
5. **High Voltage Connections:** Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
6. **Low Voltage Connections:** Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.
7. **Occupancy Sensor Inputs:** It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
  - 70mA w/1 LightSync device connected to the controller
  - 60mA w/2 LightSync devices connected to the controller
  - 50mA w/3 LightSync devices connected to the controller
  - 40mA w/4 LightSync devices connected to the controller
8. **Photocell Inputs:** It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
9. **Local Data Line Port:** It shall provide an RJ45 data line port for up to 17 LightSync data line devices. It shall provide power for LightSync devices as described in #7 or additional power added with an optional Power Supply Repeater.
10. **Dimming:** It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.

11. Pre-Configured Programs: Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.
- E. LightSync EVO Integrated 2 Room Controller: Each controller shall be designed to be remotely installed and shall provide 2 integrated load control relays with dimming.
1. Enclosure: Each controller shall be provided with a polycarbonate plastic enclosure provided with a ½” nipple and mounting tab.
  2. Plenum Rated: Each controller shall be suitable for plenum mounting. Controllers without this rating shall be unacceptable.
  3. Listing: Lighting control shall be UL/CUL listed and shall bear labels indicating compliance.
  4. Controller Power Supply: Each lighting controller shall be provided with a dual-rated, UL-listed Class 2 power supply capable of 120/277 VAC primary (50 to 60 Hz). It shall contain an internal fuse for protection.
  5. Relay Ratings: It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
    - 16A, 120/277VAC Electronic Ballast (LED)
    - 20A 120/277VAC General
    - 1/4 HP @ 120 VAC Motor Load
  6. High Voltage Connections: Each controller shall be provided with color-coded wire leads. All connections shall be made to clearly and permanently labeled terminations.
  7. Low Voltage Connections: Controllers shall also be provided with RJ45 connectors for the data lines, occupancy sensor, and photo sensor connections. Dimming shall be provided with color-coded wire leads. All connections shall be permanently labeled terminations.
  8. Occupancy Sensor Inputs: It shall have 1 input with power provided. The input shall control any or all the relays in the lighting controllers or the dimmer outputs. Each controller shall provide 24VDC total power for the occupancy sensors with the following current capabilities:
    - 70mA w/1 LightSync device connected to the controller
    - 60mA w/2 LightSync devices connected to the controller
    - 50mA w/3 LightSync devices connected to the controller

9. Photocell Inputs: It shall provide an integrated interface for 1 ILC photocell head. The photo controller shall be provided with 256 light to dark levels (0-1800fc). It shall allow the selection of 8 individual setpoints for OFF and ON and includes a selectable range of dead-band. It shall be programmable for a 2- or 30-second delay. Each set point shall control any or all the relays in the lighting controllers or the dimmer outputs.
10. Local Data Line Port: It shall provide an RJ45 data line port for up to 3 LightSync data line devices. It shall provide power for LightSync devices as described in #8 or additional power added with an optional Power Supply Repeater.
11. Dimming: It shall be provided with 2 independent 0-10V dimming control outputs that shall sink a maximum of 100mA per output. Each output shall be galvanically isolated up to 1500V to protect the electronics. Each output will revert to 100% upon a power loss.
12. Pre-Configured Programs: Each controller shall have up to 1 pre-configured default contractor program or 1 job-specific custom program.

### 2.3 LIGHTING CONTROL RELAYS:

- A. LightLEEDer Reliant40-1 Single Pole Relay: It shall be designed for controlling high-inrush single pole lighting circuits. It shall employ 4 latching nickel-silver contacts.
  1. Listing: Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
  2. Labeling: Lighting control relays shall bear labels for relay current and SCCR ratings.
  3. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
  4. SCCR: Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.
  5. Relay Ratings: It shall be rated for the following:
    - 16A, 120/277/347 VAC Electronic Ballast (LED)
    - 40A 120/277/347 VAC Ballast
    - 40A 120/277/347 VAC Tungsten
    - 1/5 HP @ 120 VAC Motor Load
    - It shall be suitable for plug-loads



6. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
  7. Auxiliary Contacts: Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
  8. Mounting: Relays shall be capable of panel mounting.
  9. Lock-Out: Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.
  10. Actuator: Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication.
- B. LightLEEDer Reliant40-2 and 3 Pole Relay:** It shall be designed for controlling high-inrush 2-, 3-pole lighting circuits. Each pole shall employ 4 latching nickel-silver contacts.
1. Listing: Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
  2. Labeling: Lighting control relays shall bear labels for relay current and SCCR ratings.
  3. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
  4. SCCR: Lighting relays shall have an SCCR rating of 18,000 amps up to 347 VAC.
  5. Relay Ratings: Each relay shall be designed for the control of 208, 240, and 480 VAC lighting loads at the following per pole.
    - 16A, 120/277/347 VAC Electronic Ballast (LED)
    - 40A 120/277/347 VAC Ballast
    - 40A 120/277/347 VAC Tungsten
    - 1/5 HP @ 120 VAC Motor Load
    - It shall be suitable for plug-loads
  6. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.

7. Auxiliary Contacts: Each Lighting control relay shall contain an auxiliary set of contacts rated at 1 AMP 30 VAC/VDC electrically isolated but mechanically linked to the main contacts for the purpose of true status monitoring and pilot light activation.
8. Mounting: Relays shall be capable of panel mounting.
9. Lock-Out: Relays shall be equipped with an Enable/Disable switch to lock out On/Off control from the controller.
10. Actuator: Relays shall be equipped with a manual actuator switch for turning the relay ON or OFF along with status indication.
11. Mechanical Link: Poles within the relay shall be electrically isolated but mechanically linked so as to open and close together without the possibility of one pole being closed while the other remains open. Systems that utilize two single-pole relays to accomplish this function are not acceptable.

C. LightLEEDer Remote R20 Single Pole Relay: The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to a 16 Amp circuit.

1. Listing: Lighting control relays shall be individually UL/CUL listed and shall bear labels indicating compliance.
2. Plenum: It shall be plenum rated.
3. Labeling: Lighting control relays shall bear labels for relay current and SCCR ratings.
4. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
5. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.
6. Relay Ratings: It shall be rated for the following:
  - 16A, 120/277/347 VAC Electronic Ballast (LED)
  - 16A 120/277/347 VAC Ballast
  - 16A 120/277/347 VAC Tungsten
  - 16A 120/277/347 VAC Resistive
  - 1/5 HP @ 120 VAC Motor Load
  - It shall be suitable for plug-loads

7. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
  8. Mounting: It shall have a ½” nipple for mounting to an enclosure or fixture
- D. LightLEEDer Remote R20D Single Pole Relay W/Dimming:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 1 load up to 16 Amp circuit and 0-10V dimming.
1. Listing: Lighting control relays shall be individually UL and CUL listed and shall bear labels indicating compliance.
  2. Plenum: Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.
  3. Labeling: Lighting control relays shall bear labels for relay current ratings.
  4. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
  5. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 277 VAC.
  6. Relay Ratings: It shall be rated for the following:
    - 16A, 120/277/347 VAC Electronic Ballast (LED)
    - 16A 120/277/347 VAC Ballast
    - 16A 120/277/347 VAC Tungsten
    - 16A 120/277/347 VAC Resistive
    - 1/5 HP @ 120 VAC Motor Load
    - It shall be suitable for plug-loads
  7. Dimming: Shall be able to control 0-10V dimming ballast and be able to sink up to 100 mA.
  8. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
  9. Mounting: It shall have a ½” nipple for mounting to an enclosure or fixture

**E. LightLEEDer Remote 20 Amp Dimming Relay with Emergency Bypass:** The remote relay shall be designed to be mounted to a junction box or fixture and shall control 2- load up to 20 Amps circuits and 0-10V dimming. It shall combine normal relay operation with UL924 bypass relay.

1. Listing: Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.
2. Plenum: Each relay shall be suitable for plenum mounting and rated to the UL 2043 standards. Controllers without this rating shall be unacceptable.
3. Labeling: Lighting control relays shall bear labels for relay current ratings.
4. Endurance: Lighting control relays shall be designed and tested to have a minimum cycle life of 200,000 ON/OFF cycles @ FULL LOAD and 2,000,000 ON/OFF cycles at no load.
5. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 347 VAC.
6. EM Function: It shall have one normal power relay and one EM relay. Both shall be controlled by a LightLEEDer controller. Upon loss of power, the EM relay shall be forced to the ON state. During the EM state, 0-10 V dimming shall be forced to 100%.
7. Relay Ratings: It shall be provided with 2- 50A load relays that shall be de-rated for 20 amps for durability:
  - 16A, 120/277VAC Electronic Ballast (LED)
  - 20A 120/277VAC General
  - 1/4 HP @ 120 VAC Motor Load
  - It shall be suitable for plug-loads
8. Latching: Lighting control relays shall be designed with a latching mechanism that shall hold the relay in its last activated state indefinitely, with no change of state during an interruption of power. Solid-state or electrically held relays are not acceptable.
9. Mounting: It shall have a 1/2" nipple for mounting to an enclosure or fixture.
10. Test Button: It shall have a test button for testing the EM function.
11. Test Input: It shall have an input for testing the EM function from a remote location.
12. Wireless Communications: It shall have a 915Mhz radio with point-to-point capabilities. It shall communicate 100 feet line-of-sight with the wireless devices.

- F. ILC EM20 Emergency Bypass Relay:** The remote relay shall be designed to be mounted to a junction box or fixture. It shall provide automatic bypass for emergency power.
1. Listing: Lighting control relays shall be individually UL/CUL/UL924 listed and shall bear labels indicating compliance.
  2. Labeling: Lighting control relays shall bear labels for relay current ratings.
  3. SCCR: Lighting relays shall have an SCCR rating of 5,000 amps up to 2777 VAC.
  4. Loads: Lighting bypass relays shall be designed for bypass of 120 or 277 VAC @ 20 amps.
  5. Bypass: It shall automatically bypass normal power upon loss of emergency power
  6. Mounting: It shall have a 1/2" nipple for mounting to an enclosure or fixture.

## 2.4 SWITCH STATIONS AND COVER PLATES

- A. Hardwired Switches and Cover Plates:** Electrical contractor shall provide and install switch plates and switches of the quantities and types shown on the drawings and specified herein.

### 1. Heavy Duty Switch

- a) Switch: It shall consist of a single-pole double-throw center OFF momentary heavy-duty toggle or Decora® paddle switch rated at 15-20 Amps @ 120/277 VAC. They shall be available in ivory or white colors.
- b) Cover Plates: Plates shall be available for Decora® switches in ivory, white, or stainless steel with or without visible screws and come in 1-4 gangs.
- c) Nomenclature: Engraving shall be available on phenolic labels or directly on the plate.

### 2. Key Switch

- a) Key Switch: Key switch shall consist of a single-pole double-throw momentary or maintained switch. They shall be available to allow the key to being removed in the ON position or the OFF position.

- b) Cover plates: Plates shall be available in stainless steel, brushed aluminum, or painted cold rolled steel. They shall be available with 1-2 switches per gang plate and up to 4 gangs.
- c) Status: LED status indicators shall be optional for each switch provided.
- d) Nomenclature: Engraving shall be available on phenolic labels or directly on the plate.

### 3. Touch Activated Switch

- a) Switch: Touch activated switch shall be a momentary output push-button with an IP65 rating.
- b) Cover plates: Plates shall be available in stainless steel, brushed aluminum, or painted cold rolled steel. They shall be available with 1-3 switches per gang plate and up to 4 gangs.
- c) Gasket: Cover plate neoprene gaskets shall be available for weatherproof applications.
- d) Status: LED status indicators rings shall be optional for each switch provided.
- e) Nomenclature: Engraving shall be available on phenolic labels or directly on the plate.

### **B. Custom Switch Plates and Graphic Switch Stations:** Electrical contractor shall provide and install custom switch plates and graphical switching stations of the quantities and types shown on the drawings and specified herein.

- a) Switch Plates: Switch plates shall consist of a control panel faceplate, switches, and other control devices as required, LED pilot lights and all mounting hardware.
- b) Material: Switch plates shall be manufactured from a single piece of stainless steel, aluminum, brass or bronze, finished and labeled as per the plans and specifications or as indicated on approved drawings.
- c) Mounting: Switch plates shall be designed to mount either to a standard electrical gang box supplied by the electrical contractor for either flush or surface mounting or to a custom back-box supplied by the manufacturer.

- d) Nomenclature: Switch plate graphics and labeling shall be accomplished through the use of one or a combination of multi-color anodized, engraving or phenolic labels; laser etched or painted graphics.
  
- e) Graphics: Each switch station shall contain a graphic representation of the controlled space with switches and other control devices graphically located on the station so as to indicate their associated areas of control.

## 2.3 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Digital and Multiplexed Signal Cables: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5e for horizontal copper cable and with Section 271500 "Communications Horizontal Cabling."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panels according to NECA 407.
- B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."

3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.3 PANEL INSTALLATION

- A. Comply with NECA 1.
- B. Install panels and accessories according to NECA 407.
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panel cabinet plumb and rigid without distortion of box.
- E. Install filler plates in unused spaces.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.
- D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Acceptance Testing Preparation:



1. Test continuity of each circuit.

D. Lighting control panel will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system according to approved configuration schedules, time-of-day schedules, and input override assignments.
3. Coordinate with owner for scheduled time for on/off of exterior lights.
4. Coordinate with owner for specific lighting scenes for gym and lobby.

### 3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the control unit and operator interface. Provide a minimum of 4 hours of training.

END OF SECTION



## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.
  - 3. Load centers.

#### 1.3 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression 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. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
  - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Two spares for each type of panelboard cabinet lock.

## 1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - a. Ambient Temperature: Not exceeding 0 deg F to plus 104 deg F.
  - b. Altitude: Not exceeding 6600 feet.

- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.11 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Flush- and surface-mounted cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1 .
    - b. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  - 5. Finishes:
    - a. Panels and Trim: Phosphatized Steel , factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel .
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
  - 6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses:
  - 1. Material: Tin-plated aluminum.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  - 3. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
  - 2. Main and Neutral Lugs: Mechanical type.
  - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  - 4. Feed-Through Lugs Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  - 6. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches] high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only. See Panel Schedules on drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only. See Panel Schedules on drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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 circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long- and short-time pickup levels.
    - c. Long- and short-time time adjustments.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - a. Standard frame sizes, trip ratings, and number of poles.



- b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
- c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
- d. Shunt Trip: 120 -V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
- f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
- g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

- E. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 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.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION



## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Weather-resistant receptacles.
  - 3. Snap switches and wall-box dimmers.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

- C. Samples: One for each type of device and wall plate specified, in each color specified.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
  2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  3. Leviton Mfg. Company Inc. (Leviton).
  4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

#### 2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  2. Devices shall comply with the requirements in this Section.

#### 2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
  1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; 5351 (single), CR5362 (duplex).
- b. Hubbell; HBL5351 (single), HBL5352 (duplex).
- c. Leviton; 5891 (single), 5352 (duplex).
- d. Pass & Seymour; 5361 (single), 5362 (duplex).

## 2.4 GFCI RECEPTACLES

### A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

### B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; VGF20.
  - b. Hubbell; GFR5352L.
  - c. Pass & Seymour; 2095.
  - d. Leviton; 7590.

### C. Duplex GFC1 Weather Resistant Receptacles, 125V, 20A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper: WRVGF20.
  - b. Pass & Seymour: 2095TRWRW.
  - c. Leviton: W7899-W.

## 2.5 TOGGLE SWITCHES

### A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

### B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - 1) Single Pole:
    - a) Cooper; AH1221.
    - b) Hubbell; HBL1221.
    - c) Leviton; 1221-2.
    - d) Pass & Seymour; CSB20AC1.
  - 2) Two Pole:
    - a) Cooper; AH1222.
    - b) Hubbell; HBL1222.
    - c) Leviton; 1222-2.
    - d) Pass & Seymour; CSB20AC2.
  - 3) Three Way:

- a) Cooper; AH1223.
- b) Hubbell; HBL1223.
- c) Leviton; 1223-2.
- d) Pass & Seymour; CSB20AC3.

## 2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.7 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
  - 3. .
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.



C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, enclosed controllers and motor-control centers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

#### 1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 20deg F or more than 104deg F , apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
  1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.

4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
1. Feeders: Class RK1, time delay .
  2. Motor Branch Circuits: Class RK1, time delay.
  3. Other Branch Circuits: Class RK1, time delay.
  4. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION



## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of NRTL listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

- C. Field quality-control reports.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Manufacturer's field service report.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

#### 1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:



1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's or Owner's written permission.
4. Comply with NFPA 70E.

## 1.8 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
  1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  4. Lugs: Mechanical type, suitable for number, size, and conductor material.
  5. Service-Rated Switches: Labeled for use as service equipment.

### 2.2 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
  2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
  3. Siemens Energy & Automation, Inc.
  4. Square D; a brand of Schneider Electric.

- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. 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.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
  - 1. Instantaneous trip.
  - 2. Long- and short-time pickup levels.
  - 3. Long- and short-time time adjustments.
  - 4. Ground-fault pickup level, time delay, and  $I^2t$  response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- I. Features and Accessories:
  - 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
  - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
  - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
  - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
  - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

## 2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 3R.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.

### 3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Overcurrent Protective Device Coordination Study."

END OF SECTION

## SECTION 265100 - INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Interior solid-state luminaires that use LED technology.

- B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260933 "Central Dimming Controls" and Section 260936 "Modular Dimming Controls" for architectural dimming systems.
3. Section 260943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

#### 1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. LED: Light-emitting diode.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting fixture, including ballast housing if provided.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Energy-efficiency data.
  - 4. Life, output (lumens, CCT, and CRI).
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
- B. Installation instructions.
- C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- E. Field quality-control reports.
- F. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.8 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  - 2. Warranty Period for Emergency and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basic of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or a comparable product. .

### 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. LED Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- F. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- b. UV stabilized.

## 2.3 LED FIXTURES

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Bulb shape complying with ANSI C79.1.
- E. Lamp base complying with ANSI C81.61.
- F. CRI of minimum 80. CCT of 3500 K.
- G. Rated lamp life of minimum 50,000 hours at L70.
- H. Lamps dimmable from 100 percent to 1 percent of maximum light output.
- I. Photometric data and adjustment factors shall be based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project, IES LM-79, and IES LM-80.
- J. LED driver shall be integral to fixture unless otherwise noted.
- K. Nominal Operating Voltage: 120 V ac through 277 V ac.
- L. Housings:
  1. Extruded-aluminum housing and heat sink.

## 2.4 EMERGENCY FIXTURE POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast or driver. Comply with UL 924.
  1. Emergency Connection: Operate fluorescent lamp(s) or array(s) of LED's continuously at an output of 1100 lumens. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Nightlight Connection: Operate one fluorescent lamp or LED array continuously.
  3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.



- a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and a flashing red LED.

## 2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
  2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is announced by an integral audible alarm and a flashing red LED.

## 2.6 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
  1. Battery: Sealed, maintenance-free, lead-acid type.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay

- disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
  7. Integral Time-Delay Relay: Holds unit on for fixed interval of 5 minutes when power is restored after an outage.
  8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260020 "Basic Materials & Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage .
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage .
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Lighting fixtures:
  1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, 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. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION



## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

- B. Related Sections:

1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Division 27 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
3. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches (152 mm) in width.
- D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.

- H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

#### 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 for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
  - 3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

## 1.7 COORDINATION

- A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
  - 1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
  - 4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
  - 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
  - 2. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 3. Lacing bars, spools, J-hooks, and D-rings.
  - 4. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

## 2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ADC.
  2. Aim Electronics; a brand of Emerson Electric Co.
  3. AMP; a Tyco International Ltd. company.
  4. Cooper B-Line, Inc.
  5. Hubbell Premise Wiring.
  6. KRONE Incorporated.
  7. Leviton Voice & Data Division.
  8. Middle Atlantic Products, Inc.
  9. Nordex/CDT; a subsidiary of Cable Design Technologies.
  10. Ortronics, Inc.
  11. Panduit Corp.
  12. Siemon Co. (The).
- B. General Frame Requirements:
1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
  2. Module Dimension: Width compatible with EIA 310 standard, 19-inch (480-mm) panel mounting.
  3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, steel or aluminum construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
  2. Baked-polyester powder coat finish.
- D. Modular Freestanding Cabinets:
1. Removable and lockable side panels.
  2. Hinged and lockable front and rear doors.
  3. Adjustable feet for leveling.
  4. Screened ventilation openings in the roof and rear door.
  5. Cable access provisions in the roof and base.
  6. Grounding bus bar.
  7. Power strip.
  8. Baked-polyester powder coat finish.
  9. All cabinets keyed alike.
- E. Modular Wall Cabinets:
1. Wall mounting.
  2. Steel or aluminum construction.
  3. Treated to resist corrosion.
  4. Lockable front and rear doors.
  5. Louvered side panels.



6. Cable access provisions top and bottom.
7. Grounding lug.
8. Power strip.
9. All cabinets keyed alike.

F. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

## 2.4 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.
2. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.
3. LED indicator lights for power and protection status.
4. LED indicator lights for reverse polarity and open outlet ground.
5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
7. Cord connected with 15-foot (4.5-m) line cord.
8. Rocker-type on-off switch, illuminated when in on position.
9. Peak Single-Impulse Surge Current Rating: 13 kA per phase.
10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

## 2.5 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

## 2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Install underground pathways complying with recommendations in TIA/EIA-569-A, "Entrance Facilities" Article.

### 3.2 Install underground entrance pathway complying with Division 26 Section "Raceway and Boxes for Electrical Systems. "INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.
- C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

### 3.3 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping. "Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
  - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems. "Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration including optional identification requirements of this standard.
- C. Labels shall be preprinted or computer-printed type.

END OF SECTION



## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pathways.
  - 2. UTP cable.
  - 3. 9/125-micrometer, optical fiber cabling.
  - 4. Cable connecting hardware, patch panels, and cross-connects.
  - 5. Cabling identification products.
- B. Related Sections:
  - 1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. RCDD: Registered Communications Distribution Designer.
- G. UTP: Unshielded twisted pair.

#### 1.4 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
  - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Maintenance Data: For splices and connectors to include in maintenance manuals.

#### 1.8 CLOSEOUT SUBMITTALS

- A. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development] by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- D. Grounding: Comply with ANSI-J-STD-607-A.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
  - 2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

#### 1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.12 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### PART 2 - PRODUCTS

#### 2.1 OPTICAL FIBER CABLE – Owner Standards

- A. Owner Standards shall take precedence over industry standards
- B. No patches or splices permitted.
- C. Minimum of 3 pair per cable.
- D. All fiber must meet OS1 specifications for single mode 9/125 duplex single mode OS1 specifications,
- E. colored yellow terminated with LC connectors in a light interface unit (LIU).
- F. OS1 is a standard single-mode optical fiber used with wavelengths 1310 nm and 1550 nm (size 9/125  $\mu\text{m}$ ) with a maximum attenuation of 1 dB/km (OS1).
- G. OS1 is defined in ISO/IEC 11801.

## 2.2 OPTICAL FIBER CABLE – Industry Standards

- A. Industry standards to be followed where owner standards do not apply.
- B. Description: Single mode (OS2), with a 9/125 $\mu\text{m}$  used with wavelength between 1310 and 1550 nm.
  - 1. Comply with ISO/IEC 24702.
  - 2. Comply with TIA/EIA-492CAAB for detailed specifications.
  - 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
    - e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.
  - 4. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
  - 5. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
- C. Jacket:
  - 1. Cable cordage jacket, fiber, unit, yellow.
  - 2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

## 2.3 OPTICAL FIBER CABLE HARDWARE – OWNER STANDARDS

- A. Owner Standards shall take precedence over industry standards
- B. All fibers must be terminated on a MDF/IDF backboard with a wall or rack mounted enclosure, LIU-Light Interface Unit, terminating fiber with LC connectors.



- C. Fiber must be enclosed in inter-duct within ceilings, enclosed in EMT conduit outside or under walkways and must include a pull cord available after fiber installation.
- D. One three-meter patch cord must be supplied for each fiber pair using the current connector configuration. All fiber patch cords must be supplied by the project vendor.

#### 2.4 OPTICAL FIBER CABLE HARDWARE – INDUSTRY STANDARDS

- A. Industry standards to be followed where owner standards do not apply.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
  - 1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.
- D. Cable Connecting Hardware:
  - 1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  - 2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
  - 3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

#### 2.5 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

#### 2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

#### 2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.

- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 271100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568-B.3.
  - 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- D. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
  - 1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
  - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

- b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
  4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
  6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  1. Administration Class: 1
  2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.
  - D. Comply with requirements in Section 271500 "Communications Horizontal Cabling" for cable and asset management software.
  - E. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
  - F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
  - G. Cable and Wire Identification:
    - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
    - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
    - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
    - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
      - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
      - b. Label each unit and field within distribution racks and frames.
    - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  - H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:
    - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.
- 3.7 FIELD QUALITY CONTROL
- A. Perform tests and inspections.
  - B. Tests and Inspections:
    - 1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
    - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Optical Fiber Cable Tests:
  - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - b. Link End-to-End Attenuation Tests:
    - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
    - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

## SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Pathways.
- 2. UTP cabling.
- 3. Multiuser telecommunications outlet assemblies.
- 4. Cable connecting hardware, patch panels, and cross-connects.
- 5. Telecommunications outlet/connectors.
- 6. Cabling system identification products.
- 7. Cable management system.

- B. Related Sections:

- 1. Division 27 Section "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
- 2. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

#### 1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.

- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- L. RCDD: Registered Communications Distribution Designer.
- M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- O. UTP: Unshielded twisted pair.

#### 1.4 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
  - 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.



## 1.6 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  - 3. Cabling administration drawings and printouts.
  - 4. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 5. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.
  - 6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
    - a. Vertical and horizontal offsets and transitions.
    - b. Clearances for access above and to side of cable trays.
    - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.
- G. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development by an RCDD.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- B. Testing Agency Qualifications: An NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- F. Grounding: Comply with ANSI-J-STD-607-A.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of UTP cable for open and short circuits.

## 1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

### 1.11 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Patch-Panel Units: One of each type.
  - 2. Connecting Blocks: One of each type.

## PART 2 - PRODUCTS

### 2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."
  - 1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

### 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Division 06 Section "Rough Carpentry" for plywood backing panels.

### 2.3 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Belden CDT Inc.; Electronics Division.
  - 2. Berk-Tek; a Nexans company.
  - 3. CommScope, Inc.
  - 4. Draka USA.
  - 5. Genesis Cable Products; Honeywell International, Inc.
  - 6. KRONE Incorporated.
  - 7. Mohawk; a division of Belden CDT.
  - 8. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 9. Superior Essex Inc.
  - 10. SYSTIMAX Solutions; a CommScope, Inc. brand.

11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

- B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

#### 2.4 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Technology Systems Industries, Inc.
  2. Dynacom Corporation.
  3. Hubbell Premise Wiring.
  4. KRONE Incorporated.
  5. Leviton Voice & Data Division.
  6. Molex Premise Networks; a division of Molex, Inc.
  7. Nordex/CDT; a subsidiary of Cable Design Technologies.
  8. Panduit Corp.
  9. Siemon Co. (The).
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

- G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm); terminated with eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.

## 2.5 OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Workstation Outlets: Two-port-connector assemblies mounted in single faceplate.
  - 1. Plastic Faceplate: High-impact plastic. Coordinate color with Division 26 Section "Wiring Devices."
  - 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  - 3. Legend: Machine printed, in the field, using adhesive-tape label.
  - 4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.6 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with ANSI-J-STD-607-A.

## 2.7 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

## 2.8 COAXIAL CABLE

- A. General Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- B. RG-6/U: NFPA 70, Type CATV or CM.
  - 1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
  - 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.
  4. Suitable for indoor installations.
- C. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV.
  2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
  3. CATV Riser Rated: Type CATVR, complying with UL 1666.
  4. CATV Limited Rating: Type CATVX.

## 2.9 COAXIAL CABLE HARDWARE

- A. Coaxial-Cable Connectors: Type BNC, 75 ohms.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

### 3.2 WIRING METHODS

- A. Wiring Method: Install cables in raceways in conduit in all exposed locations.
1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.3 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches (76 mm) above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

### 3.4 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Install 110-style IDC termination hardware unless otherwise indicated.
  - 4. MUTOA shall not be used as a cross-connect point.

5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
    - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    - b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
  6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
  10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
  13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-B.2.
  2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:



- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
- a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

### 3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.6 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
  - 1. Administration Class:2.
  - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.
- E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
  - 1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables use flexible vinyl or polyester that flex as cables are bent.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. UTP Performance Tests:
  - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
    - 1) Wire map.
    - 2) Length (physical vs. electrical, and length requirements).
    - 3) Insertion loss.
    - 4) Near-end crosstalk (NEXT) loss.
    - 5) Power sum near-end crosstalk (PSNEXT) loss.
    - 6) Equal-level far-end crosstalk (ELFEXT).
    - 7) Power sum equal-level far-end crosstalk (PSELFEXT).

- 8) Return loss.
  - 9) Propagation delay.
  - 10) Delay skew.
6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
- a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
  - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION

## SECTION 283111 - FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The complete installation shall conform to the applicable sections of NFPA 72 and NFPA 70, National Electrical Code.
- C. NFPA 90A
- D. NFPA 101
- E. Americans with Disabilities Act
- F. ASME/ANSI A17.1 and A17.3

#### 1.2 SUMMARY

- A. This section includes fire alarm system components that include, but are not limited to, the following:
  - 1. Fire-alarm control unit.
  - 2. Power supplies
  - 3. Single and multiple station smoke alarms.
  - 4. Addressable manual fire-alarm stations.
  - 5. Addressable smoke detectors.
  - 6. Addressable heat detectors.
  - 7. Notification appliances.
  - 8. Magnetic door holders.
  - 9. Remote annunciator.
  - 10. Radio alarm transmitter.
  - 11. Addressable monitoring and control interface devices.
  - 12. Digital alarm communicator transmitter.
- B. 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 as shown on the drawings, as specified, and as directed by the Architect/Engineer.
- C. The work covered by this section of the specification shall be coordinated with the related work as specified elsewhere under the project specifications.

### 1.3 SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS

- A. General: Connect new fire alarm devices indicated to the existing fire alarm system at the school. All new devices shall be compatible and shall be UL listed for use with the existing FACP.
- B. The fire alarm system shall allow for loading and editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation. All software-programmed operations shall be stored in a non-volatile memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.
- C. All control equipment must have transient protection to comply with UL864 requirements.
- D. Where Fire Alarm circuits leave the building, additional transient protection must be provided for each circuit. Devices must be UL listed under standard # 497B.
- E. System connections for alarm-notification circuits and voice/alarm communication circuits shall be Class B/Style Y.
- F. System connections for signaling line addressable device circuits shall be Class B/Style 4.
- G. System connections for initiating device circuits shall be Class B/Style B.
- H. It shall be possible to monitor the system remotely over the internet via an Ethernet connection to a Local Area Network.
- I. Power supplies, signaling line circuits, initiating device circuits, notification appliance circuits, control equipment, and control panel components shall all be sized and designed so that no more than 75% of the capacity of the circuit / component is utilized. For example, no more than 75 addressable devices shall be connected to a signaling line circuit with a capacity of 100 devices; notification appliance circuits with a capacity of 2 amps shall not be loaded any greater than 1.5 amps; and power supplies rated for 4 amps shall not be loaded any greater than 3 amps.
- J. All audio circuits shall be sized and designed so that no more than 50% of the circuit's capacity is utilized in the original design. Amplifiers shall be sized for 150% of the design load or 1-watt per speaker, whichever is greater. The extra capacity shall allow for increasing speaker wattage taps or adding speakers in the field as necessary to achieve NFPA audibility requirements.
- K. Power Requirements
  - 1. All control panels and power supplies shall receive 120 VAC power via dedicated circuits. Circuit breakers serving fire alarm control equipment shall have a red marking, shall be accessible to authorized personnel only, and shall be identified as service fire alarm control equipment. The location of the circuit breaker or circuit disconnecting means shall be permanently identified at the associated fire alarm control unit.
  - 2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in normal supervisory mode for a period of 24 hours plus an additional 15 minutes of alarm operation at the end of this period. Provide 25%

spare battery capacity for future expansion. Include additional battery cans and chargers as necessary.

3. The system shall automatically transfer to battery standby upon normal power failure. All battery charging and recharging operations shall be automatic.
4. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visibly indicated at the control unit.

L. System Survivability:

1. Smoke detectors shall be placed above each fire alarm system control unit, including remote power supplies and amplifiers, in accordance with NFPA 72.
2. Where indicated on plans, or where fire alarm cables pass from floor to floor, or from one fire zone to another, cables shall be of the 2-hour rated circuit integrity type. This shall apply to all cables, including communication cables, notification appliance circuits, signaling line circuits, audio circuits, initiating device circuits, etc.

M. Smoker Detector Sensitivity and Environmental Compensation:

1. The FACP / detector shall maintain a moving average of the detector's smoke chamber value to automatically compensate (move the threshold) for dust, dirt, and component degradation conditions that could affect detection operations. The control unit / detector shall automatically maintain constant smoke obscuration sensitivity for each sensor by compensating for environmental factors.
2. The FACP shall automatically indicate when individual detectors are excessively dirty, dirty, or almost dirty so that maintenance can be done on all detectors simultaneously.
3. The FACP shall be listed for automatic compliance with NFPA 72 sensitivity testing requirement.
4. Remote Smoke-Detector Sensitivity Adjustment: The sensitivity of each addressable detector shall be able to be remotely adjusted and displayed at the FACP. Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings.
5. Day / Night Sensitivity: It shall be possible to program automated changes in sensitivity of specific detector groups based on repetitive time schedules.

#### 1.4 SYSTEM SEQUENCE OF OPERATION

A. Alarm Sequence: Upon activation of any manual station or any automatic alarm detection device the following shall take place:

1. An audible and visual general alarm condition shall be indicated at the FACP and the annunciators.
2. The alarm shall be recorded in a separate alarm history log.
3. Audible and visible alarm notification signals throughout the building are activated. Alarms shall remain on until silenced by the alarm silence switch at the FACP. Any subsequent alarm shall reactivate the alarm notification appliances.
4. All smoke doors on the floor of alarm normally held open by magnetic door holders shall be released after a 5-second delay.
5. All designated egress doors shall be unlocked.
6. Supply and return fans serving the area where the alarm originated shall be shut down.
7. Stairwell pressurization fans shall be started.

8. The building automatic temperature control system shall be signaled to begin smoke control sequences.
  9. A supervised alarm signal shall be transmitted to notify the monitoring station.
- B. Supervisory and Trouble Sequence: Upon detecting any trouble or supervisory condition, the following shall take place:
1. An audible signal shall sound and the associated visual signal shall illuminate at the FACP and the annunciators. Audible and visual differentiation between supervisory and trouble conditions shall be provided. The differentiation shall be clearly identified in plain-language on the FACP alphanumeric display.
  2. A record of the supervisory or trouble condition shall be kept in the associated FACP historical log.
  3. Trouble and supervisory conditions shall initiate the transmission of a supervised trouble or supervisory signal, respectively, to the monitoring station.
- C. Positive Alarm Sequence: Upon activation of any automatic fire detection device selected for positive alarm sequence, the following shall take place:
1. The alarm shall be acknowledged at the FACP within 15 seconds of initiation to initiate an alarm investigation phase and postpone the alarm sequence. If the signal is not acknowledged within 15 seconds, alarm notification shall proceed in accordance with the alarm sequence.
  2. After acknowledgement of the alarm within the 15 second acknowledgement period, trained personnel shall have up to 3 minutes to investigate the cause of the alarm. If the alarm is deemed by trained personnel to be false, and system is reset within the investigation phase, the alarm sequence shall be cancelled.
  3. If the system is not reset within the investigation phase, the alarm sequence shall be initiated.
  4. If a second automatic fire detector or other manual or automatic alarm detection device is activated during the investigation phase, the alarm sequence shall be immediately initiated.
  5. A means shall be provided to manually bypass or disable the positive alarm sequence.
- D. Elevator Recall Sequence: The activation of any elevator lobby, elevator pit, elevator shaft, or elevator machine room smoke detector shall, in addition to the alarm sequences listed above, cause the associated elevator cabs to be recalled according to the following sequence:
1. If the alarmed device is on any floor other than the main level of egress, the elevator cabs shall be recalled to the main level of egress.
  2. If the alarmed device is on the main egress level, the elevator cabs shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.
- E. Elevator Shunt Trip Sequence: The activation of any elevator pit, elevator shaft, or elevator machine room heat detector shall, in addition to the operations listed above for elevator recall, cause the associated elevators to be shunt tripped [and shall open a solenoid valve to allow water to flow to the associated sprinkler head]. Power to the shunt trip coil shall be supervised by the system, and loss of power to the shunt trip control circuit shall initiate the supervisory sequence.



- F. AHU Shutdown Sequence: The activation of any duct-mounted smoke detector shall, in addition to the alarm sequence indicated above, cause the associated air handling unit to be shut down.
- G. Smoke Damper Control Sequence: Activation of a duct-mounted smoke detector located upstream of a smoke damper shall, in addition to the alarm sequence indicated above, cause the associated smoke damper to be shut.
- H. Door Holder Sequence: The activation of a smoke detector within 5 feet of a smoke door shall cause, in addition to the above alarm sequence, the associated smoke door to close.

#### 1.5 ACTION SUBMITTALS

- A. General: Comply with Louisiana State Fire Marshal Requirements. Include review fee in bid price for system.
- B. Product Data: For each type of product specified, including performance parameters and installation details.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  - 2. Include power calculations indicating exactly what devices (and how much current they draw) are on each notification appliance circuit. Include voltage drop calculations for notification appliance circuits.
  - 3. Include battery-size calculations.
  - 4. Include voice/alarm signaling-service amplifier power calculations.
  - 5. Include a riser diagram showing all panel interconnections and the quantity of devices on each circuit.
  - 6. Include floor plans to indicate all panel and device locations showing address of each addressable device.
  - 7. Include a list of labels for every addressable device in the system for approval by the Owner prior to programming.
  - 8. Include a wire legend describing the manufacturer's recommended cables and cable characteristics.
  - 9. Include a project-specific system sequence of operation description.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
  - 3. Record copy of site-specific software.

4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
  - a. Frequency of testing of installed components.
  - b. Frequency of inspection of installed components.
  - c. Requirements and recommendations related to results of maintenance.
  - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Final device address list.

#### 1.7 QUALITY ASSURANCE

- A. System installers shall be trained and certified by the equipment manufacturer for installation of units required for this Project. At a minimum, installation shall be supervised by personnel certified by NICET as a fire-alarm Level III technician.
- B. Shop Drawings shall be prepared by persons with the following qualifications:
  1. Trained and certified by manufacturer in fire-alarm system design.
  2. Licensed or certified by authorities having jurisdiction.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from a single source and from a single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: U.L. listed and labeled by a qualified testing agency and marked for intended location and application.
- E. Fire alarm system installer shall be located within 50 miles of the project location and shall have a minimum of 5 years experience in installing such systems.
- F. Fire alarm system service provider shall be located within 50 miles of the project location and shall have a minimum of 10 years experience in servicing such systems.

#### 1.8 WARRANTY

- A. The entire fire alarm system shall be warranted free from defects in material and workmanship for a period of one year from the date of final system acceptance.

#### 1.9 SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Provide a full service and maintenance contract for the system, for the duration of the warranty period. Agreement shall include all equipment, labor, programming, testing, and adjusting as necessary during the warranty period to maintain a fully-functional, code-compliant system. Contract shall include a minimum of two visits for detector sensitivity adjustments.

## PART 2 - PRODUCTS

### 2.1 REMOTE POWER SUPPLIES

- A. Where additional notification power is required, provide remote power supplies as necessary to support the notification load.
- B. Remote power supplies shall have a minimum of 4 DC output circuits and 8 amps of available power.
- C. Mount remote power supplies as necessary in locations to be approved by the owner. Show remote power supply locations on submittal shop drawings.

### 2.2 VOICE EVACUATION PANEL

- A. General: Where the protected premises does not exceed two stories, the quantity of speakers does not exceed 40, and the expected load does not exceed 40-watts, a separate voice-evacuation panel with integral battery backup may be used in lieu of a voice communications system integral to the FACP. The panel shall have all of the same features specified for the voice communications system in paragraph 2.1.
- B. Voice evacuation panel shall be compatible with the FACP. It shall include a microphone, tone generator, audio controller, and control switches all within a single enclosure.
- C. Voice evacuation panel shall include a minimum of 4 audio output circuits and 80 watts of available power.
- D. Install new voice evacuation panel in wellness center building.

### 2.3 BATTERIES

- A. Batteries shall be sealed lead-acid, maintenance-free-type. Size all batteries to meet the requirements set in paragraph 1.3 "SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS"

### 2.4 REMOTE SYSTEM ANNUNCIATOR

- A. Annunciators shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the system FACP.
- B. Mounting: Flush cabinet, NEMA 250, Type 1.
- C. Operator keys shall be key-switch enabled to prevent unauthorized use, The key shall only be removable in the disabled position.
- D. Annunciators shall display alarm, trouble, and supervisory status information for every device connected to the system.

## 2.5 MANUAL FIRE-ALARM STATIONS

### A. General Requirements: Comply with UL 38.

1. Pull stations shall be addressable, Single-action type, fabricated of high impact red polycarbonate, and finished in red with molded, raised-letter operating instructions of contrasting color.
2. Station Reset: Key- or wrench-operated switch.
3. Stations shall show visible indication of operation; and shall be mounted on recessed outlet box. If surface mounting is required by field conditions, provide manufacturer's red-painted surface back box.
4. Indoor Protective Shield: Where indicated on drawings, provide a factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation. The horn shall be rated at a minimum of 85 dB at 10 feet and shall be powered by a 9-volt battery.
5. Weatherproof Protective Shield: When located outside or in high humidity areas, provide a weatherproof, factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.6 ADDRESSABLE DETECTORS, BASES, AND HOUSINGS

### A. General Requirements:

1. Integral Addressable Module: Arranged to communicate detector information to the fire-alarm control panel, to program detector sensitivity from the FACP, and to control programmable base / housing functions.
2. Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base or is inside a protective housing. Provide terminals in the fixed base / housing for connection to building wiring.
3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
4. Integral Visual-Indicating Light: LED type indicating detector activation and power-available status.
5. Supervision: Removal of a detector head from its base / housing shall cause a trouble signal at the FACP.

### B. Detector Bases for Spot-Type Detectors: Bases shall be compatible with detector installed and shall provide for a quick and secure detector plug-in. Detectors without separate bases will not be allowed. Wiring connections shall be via screws accepting conductors in sizes from 24 AWG to 14 AWG.

1. Sounder Bases: Where noted on plans, detectors shall be provided with programmable sounder bases. It shall be possible to program the sounder to operate on local or general alarm conditions. Sounder shall be rated a minimum of 85 dB and shall implement the NFPA 72 standard "temporal 3 coded" evacuation signal. It shall be possible for several sounders in a common area to be synchronized. As an added security feature, sounder bases shall be provided with a mechanical locking feature for the detector, preventing unauthorized removal of a detector from the base.

2. Relay Bases: Where noted on plans, bases shall be equipped with a latching relay (reset from the FACP) having 1 form C contact rated a minimum of 2-amperes at 24-volts DC. The relay shall operate whenever the associated detector activates.
  3. Isolator Bases: Where indicated on plans, or where signaling line circuits extend from floor-to-floor or from one fire zone to another, isolator bases shall be provided to prevent any single fault from impacting the entire signaling line circuit. Bases shall isolate both short circuits and ground faults on the SLC. The address of the detector with an activated isolation relay shall be communicated to the FACP.
- C. Heat Detectors: U.L. 521. Analog, addressable, rate compensated, communicating actual temperature information to the FACP
1. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
  2. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
- D. Photoelectric Smoke Detectors: U.L. 268. Analog, addressable, operating on the light scattering principle of smoke detection, communicating % per foot obscuration information to the FACP.
1. Sensitivity Range: 0.5% to 3.5% per foot of smoke obscuration.
  2. Air velocity range: 0-2000 ft/min (minimum).
- E. Spot-Type Carbon Monoxide Detectors: UL 2075. Analog, addressable detector operating on electrochemical or IR sensing technology, communicating ppm of CO detected to the FACP.
1. LED's indicate normal, alarm, and end-of-life conditions.
  2. Integral, code 4 temporal sounder activates during alarm conditions. Sounder shall be rated a minimum of 85 dB.
- F. Duct-Mounted Smoke Detector: U.L. 268A. Analog, addressable, photoelectric smoke detector, communicating % per foot obscuration information to the FACP, mounted in a protective housing that accommodates sampling tubes and is suitable for mounting to HVAC ductwork.
1. Protective Housing: Impact resistant, [weatherproof], suitable for mounting to either round or rectangular ducts, listed for use with the supplied detector.
  2. Sensitivity Range: 0.5% to 3.5% per foot of smoke obscuration
  3. Air velocity range: 300-4000 ft/min (minimum).
  4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions.
  5. Relay Fan Shutdown: Form C contact rated to interrupt fan motor-control circuit.
  6. Remote alarm/test station: Provide a remote alarm test station for each concealed, duct-mounted smoke detector in accordance with NFPA 72. Locate alarm / test station in a visible location, near the concealed detector.

## 2.7 ADDRESSABLE INTERFACE DEVICES

- A. Description: Addressable, completely supervised control and monitor modules as required for a completely addressable system. The use of panel mounted conventional zone or relay circuits is not acceptable unless otherwise indicated on drawings. Modules shall mount in a standard

electrical outlet box and shall be compatible with other addressable devices on the same signaling line circuit.

- B. Addressable Control Module: Programmable relay with contacts rated a minimum of 1-amp at 24-volts DC, ½-amp at 120-volts AC.
- C. Addressable Monitor Module: Provides class B supervision of a set of dry contacts and communicates status back to the FACP.
- D. Addressable Signal Modules: Class A or class B supervised notification appliance circuit for selective control of specific horns, strobes, or speakers.
- E. Addressable Zone Module: Class A or class B supervised initiating device circuit for monitoring a zone of conventional devices with an addressable panel. Module shall be U.L. cross-listed with the devices / zone monitored.
- F. Addressable, Analog Input Module: U.L. listed as both Process Management Equipment and Fire Detection and Control Equipment. Interfaces a standard 4-20 mA output from a loop-powered transmitter to the FACP. Field-calibrated to communicate actual readings (such as ppm from a gas sensor / transmitter) to the FACP. It shall be possible to generate up to three threshold levels based on input current. Threshold levels can be configured as "alarm", "trouble", "supervisory", or "priority 2".

## 2.8 ISOLATOR MODULES

- A. Addressable relay residing on the signaling line circuit that isolates devices downstream of the relay from the FACP and devices upstream of the relay upon detecting a short or ground fault on the circuit.

## 2.9 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visual notification devices in a single mounting assembly. The audible and visual characteristics shall be as specified for each individual device, herein.
  - 2. Circular shape when mounted in ceiling; square or rectangular shape when mounted in wall.
  - 3. Where required by drawings provide protective guards that are UL listed with the device it is intended to protect.
  - 4. Color: Unless noted otherwise, devices shall be white when mounted in ceilings and red when mounted in or on walls Surface-mounted back boxes shall be of the same color as the device mounted in it.
- B. Fire Alarm Speakers: U.L. 1480. Speakers shall be 4-inch cone type with a frequency response from 400 Hz to 4 kHz. Speakers shall have power taps up to a minimum of 2 watts. Tap speakers to provide a minimum of 85dB at 10 feet from the speaker. Re-tap speakers as

necessary to achieve a sound level of 15dB above the actual ambient noise. All audible speaker pre-tones shall be in the NFPA recognized temporal code 3 format.

1. Mounting: Recessed in a 4-inch square handy box with extension ring or surface-mounted in matching, finished surface box furnished by the manufacturer of the device.
2. Weatherproof: Rated for outdoor use where located outside or denoted as weatherproof on plans, furnished with weatherproof boxes, plates, or gaskets as required.
3. Dual Voltage: Suitable for connection to 25- or 70-volt RMS notification appliance speaker circuits. Voltage shall be field selectable.

C. Visible Notification Appliances: U.L. 1971, unless noted or specified otherwise. Xenon strobe lights with clear lens mounted on an aluminum faceplate. The word "FIRE" shall be engraved in minimum 1-inch- (25-mm-) high letters on the faceplate.

1. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
2. Mounting: Recessed in a 4-inch square handy box or surface-mounted in matching, finished surface box furnished by the manufacturer of the device.
3. Weatherproof: U.L. 1638. Rated for outdoor use where located outside or denoted as weatherproof on plans, furnished with weatherproof boxes, plates, or gaskets as required.
4. Flashing shall be in a temporal pattern, synchronized with audible units. All strobes on the same notification appliance circuit shall be synchronized.

## 2.10 MAGNETIC DOOR HOLDERS

- A. Electromagnetic type holders, 24 VDC, developing a minimum of 25 pounds of holding force. Door holders / closers shall be wall mounted as indicated.

## 2.11 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
  2. U.L. listed with the device it is intended to protect.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 and manufacturer's installation instructions for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

- C. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Furnish additional hardware, software, power supplies, programming, and testing as necessary to accommodate the additional equipment. Verify existing batteries can provide adequate standby power in accordance with paragraph 1.3 and replace if they cannot.
  - 3. Expand, modify, and supplement existing equipment and wiring as necessary to extend existing monitoring, control, and notification functions to the new devices or area. New components shall be capable of merging with existing configuration without degrading the performance of the system.
- D. Manual Stations: Mount with operating handle 48-inches above finished floor, unless otherwise noted on plans. Mount within 5 feet of the exit doorway served. For doorway openings over 40-feet, provide a station on each end, within 5-feet of the opening.
- E. Spot Type Smoke and Heat Detectors: Install where shown on drawings in accordance with NFPA 72 guidelines. Conflicts between plans and NFPA 72 requirements shall be brought to the immediate attention of the Engineer for resolution prior to device installation. No additional compensation will be provided for removal of detectors installed in violation of NFPA 72 requirements. Where field conditions are not as illustrated on plans, or where field changes impact device locations, notify the Engineer for resolution.
  - 1. Locate a minimum of 3-feet from a supply air diffuser.
  - 2. Locate a minimum of 12-inches from a light fixture.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Air Sampling Type Smoke Detectors: Install in accordance with manufacturer's instructions, in locations readily accessible for maintenance.
- H. Heat Detectors for Elevator Control: Coordinate temperature rating and location with sprinkler ratings and locations. Locate within 2-feet of each sprinkler head.
- I. Remote Status and Alarm Indicators: Furnish and install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- J. Addressable Monitor and Control Modules: Mount within 3-feet of the device to be monitored or controlled.
- K. Wall-mounted notification devices: Install 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower, as measured from the bottom of the device.
- L. Fire Alarm Visual Notification Devices in Sleeping Areas:
  - 1. Wall-mounted: 110cd visual notification devices, mounted 24 inches below the ceiling, within 16 feet of the pillow, as measured from the bottom of the device.
  - 2. Ceiling-mounted: 177cd, mounted within 16 feet of the pillow.



### 3.2 CABLE INSTALLATION

- A. Install wiring in metal raceway according to Division 26 Section "Raceways." Conceal raceways except in unfinished spaced and as indicated on plans.
- B. Install conductors in enclosures parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the wiring diagrams of the system. Make all connections with approved crimp-on terminal spade lugs pressure-type terminal blocks or plug connectors.
- C. Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where any circuit tap is made.
- D. Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction (AHJ) and shall be installed in accordance with the appropriate articles from the current approved edition of the National Electric Code.
- E. Color-code fire alarm cables with a red overall jacket. Paint fire alarm system junction boxes and covers red.

### 3.3 PIPING AND SAMPLING TUBES FOR AIR SAMPLING TYPE SMOKE DETECTORS

- A. Piping shall be supported to structure with listed and manufacturer-approved clamps, straps, or hangers spaced no more than 5-feet on center.
- B. Piping shall be joined with approved couplings and shall allow for expansion. Joints shall be air-tight. For non-metallic piping, an approved solvent cement shall be used at all joints except at entry to the detector.
- C. Where false ceilings are installed, piping shall be connected to sampling points with listed, approved, flexible tubing. Tubing length shall not exceed 6-feet without approval from the manufacturer and Engineer.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 GROUNDING

- A. Ground equipment and cable shields as specified by the equipment manufacturer.
- B. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

### 3.6 FIELD QUALITY CONTROL

- A. Provide the services of a NICET level III project installation manager to supervise the total installation, including the field assembly and connection of components.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72. Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.
  - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  - 4. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Provide a written record of inspections, test, and detailed test results in the form of a test log. Submit log to the owner upon the satisfactory completion of tests.
- G. Perform a final test as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Demonstrate that the system meets the specifications and complies with applicable standards. This final test shall be witnessed by a representative of the Authority Having Jurisdiction, the Engineer, [a representative of the Owner], [the Architect], and a factory-authorized service representative.

### 3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide a minimum of 4 hours of training.

END OF SECTION

## SECTION 312000 – EARTHWORK

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Excavation, filling, compacting and grading operations both inside and outside building limits as required for below-grade improvements and to achieve grades and elevations indicated. Provide trenching and backfill for mechanical and electrical work and utilities.
- B. Subbase materials, drainage fill, common fill, and structural fill materials for slabs, pavements, and improvements.
- C. Suitable fill from off-site if on-site quantities are insufficient or unacceptable, and legal disposal of excess fill off-site.
- D. Rock excavation without blasting unless blasting is specifically authorized.

#### 1.2 RELATED SECTIONS

- A. Section 015639 – Tree Protection and Trimming

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- B. Test Reports: Submit for approval test reports, list of materials and gradations proposed for use.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum 2-year experience installing similar products.

#### 1.5 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- B. Handling: Handle materials to avoid damage.

### 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

### 1.8 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Substitutions: Not permitted.
- B. Requests for substitutions will be considered in accordance with provisions in project manual.

### 2.2 MATERIALS

- A. Earthwork:
  1. Subbase Material: Graded gravel or crushed stone.
  2. Bedding Course: Graded crushed gravel and sand.
  3. Borrow Soil: Off-site soil for fill or backfill.
  4. Drainage Fill: ashed gravel or crushed stone.
  5. Common Fill: Mineral soil free from unsuitable materials.
  6. Structural Fill: Graded gravel.
  7. Impervious Fill: Gravel and sand mixture.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.2 INSTALLATION

- A. Excavation is unclassified and includes excavation to subgrade regardless of materials encountered. Repair excavations beyond elevations and dimensions indicated as follows:
  1. At Structure: Concrete or compacted structural fill.
  2. Elsewhere: Backfill and compact as directed.
- B. Maintain stability of excavations; coordinate shoring and bracing as required by authorities having jurisdiction. Prevent surface and subsurface water from accumulating in excavations. Stockpile satisfactory materials for reuse, allow for proper drainage and do not stockpile materials within drip line of trees to remain.
- C. Compact materials at the optimum moisture content as determined by ASTM D 1557 by aeration or wetting to the following percentages of maximum dry density:

- D. Structure, Pavement, Walkways: Subgrade and each fill layer to 95 percent of maximum dry density to suitable depth.
- E. Unpaved Areas: Top 6 inches of subgrade and each fill layer to 90 percent maximum dry density.
- F. Place acceptable materials in layers not more than 8 inches loose depth for materials compacted by heavy equipment and not more than 4 inches loose depth for materials compacted by hand equipment to subgrades indicated as follows:
  - 1. Structural Fill: Use under foundations, slabs on grade in layers as indicated.
  - 2. Drainage Fill: Use under designated building slabs, at foundation drainage and elsewhere as indicated.
  - 3. Common Fill: Use under unpaved areas.
  - 4. Subbase Material: Use under pavement, walks, steps, piping and conduit.
- G. Grading Tolerances Outside Building Lines:
  - 1. Lawns, unpaved areas, and walks, plus or minus 1 inch.
  - 2. Pavements, plus or minus 1/2 inch.
- H. Grading Tolerance for Fill Under Building Slabs: Plus or minus 1/2 inch measured with 10-foot straightedge.
- I. Protect newly graded areas from traffic and erosion. Recompact and regrade settled, disturbed and damaged areas as necessary to restore quality, appearance, and condition of work.
- J. Control erosion to prevent runoff into sewers or damage to sloped or surfaced areas.
- K. Control dust to prevent hazards to adjacent properties and vehicles. Immediately repair or remedy damage caused by dust including air filters in equipment and vehicles. Clean soiled surfaces.
- L. Dispose of waste and unsuitable materials off-site in a legal manner.

END OF SECTION 312000

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## SECTION 312316 – EXCAVATION

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Excavating for slabs-on-grade, paving, and utilities within the building.

#### 1.2 RELATED REQUIREMENTS

- A. Section 017300 - Execution Requirements
- B. Section 312323 - Fill and Backfill: Fill materials, filling, and compacting.

#### 1.3 PROJECT CONDITIONS

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.

### PART 2 - PRODUCTS (Not Used)

#### 2.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

#### 2.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Notify utility company to remove and relocate utilities.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

#### 2.3 EXCAVATING

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- D. Do not interfere with 45 degree bearing splay of foundations.
- E. Cut utility trenches wide enough to allow inspection of installed utilities.
- F. Hand trim excavations. Remove loose matter.
- G. Correct areas that are over-excavated and load-bearing surfaces that are disturbed



- H. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- I. Remove excavated material that is unsuitable for re-use from site.
- J. Remove excess excavated material from site.

#### 2.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

#### 2.5 PROTECTION

- A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION

## SECTION 312323 – SELECT FILL AND BACKFILL

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Filling, backfilling, and compacting for footings, slabs-on-grade, paving, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.
- C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

#### 1.2 RELATED REQUIREMENTS

- A. Section 312316 - Excavation: Removal and handling of soil to be re-used.
- B. Section 033000 - Cast-in-Place Concrete.

#### 1.3 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

#### 1.4 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2009.
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2007.
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- D. ASTM D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN m/m<sup>3</sup>)); 2007.
- E. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- F. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2006.
- G. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- H. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

- I. ASTM D 4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2005.

#### 1.5 SUBMITTALS

- A. See Section 013300 - Submittal Procedures.
- B. Samples: 10 lb sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
  - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
  - 2. Prevent contamination.
  - 3. Protect stockpiles from erosion and deterioration of materials.

### PART 2 - PRODUCTS

#### 2.1 SELECT FILL MATERIALS

- A. Select Fill - Mississippi River pump sand or approved equal.
- B. Sand - Fill Type Mississippi River pump sand.: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
  - 1. Acceptable ASTM D2478 grades: GW, GP, GM, SM, SW, and SP.
  - 2. Maximum plasticity index = 25.
  - 3. Maximum liquid limit = 45%
  - 4. Free of roots, clay lumps, or other deleterious material
  - 5. Less than 10% passing No. 200 sieve
  - 6. Maximum organic content = 5% by weight.

#### 2.2 ACCESSORIES

- A. Vapor Retarder: See Cast in Place Concrete 033000

#### 2.3 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. Where fill materials are specified by reference to a specific standard, testing of samples for compliance will be provided before delivery to site.

- C. If tests indicate materials do not meet specified requirements, change material and retest.
- D. Provide materials of each type from same source throughout the Work.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Identify required lines, levels, contours, and datum locations.
- C. Verify subdrainage, dampproofing, or waterproofing installation has been inspected.
- D. Verify structural ability of unsupported walls to support imposed loads by the fill.

#### 3.2 PREPARATION

- A. Scarify subgrade surface to a depth of 6 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with select fill. as required by Section 3.3 Filling of this Specification.
- C. Compact any disturbed subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.
- E. Comply with any other directions of applicable project Geotechnical Report.
- F. Sheeting, shoring, and associated excavation shall be performed in accordance with OSHA guidelines and is the Contractor's responsibility.

#### 3.3 FILLING

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 8 inches compacted depth.
- G. Correct areas that are over-excavated.
  - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.

- H. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving, slabs-on-grade, and similar construction: 95 percent of maximum dry density.
- I. Comply with any other directions of applicable project Geotechnical Report.
- J. Backfill both sides of all foundation and retaining walls equally until low side is up to finish grade. Do not backfill any walls until concrete has reached its specified 28-day compressive strength.

#### 3.4 TOLERANCES

- A. Top Surface of General Filling: Plus or minus 1 inch from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch from required elevations.

#### 3.5 FIELD QUALITY CONTROL

- A. Perform in situ compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 1557 ("Modified Proctor")
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: 1/250 s.f or 1/25 l.f. trench.
- E. Testing agency shall be retained by the Owner or Contractor.

#### 3.6 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION

## SECTION 312333 – TRENCHING FOR SITE UTILITIES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Trenching and backfilling of utility trenches
- B. Quality control on site
- C. Cleaning upon project completion

### PART 2 - PRODUCTS

#### 2.1 FILL MATERIALS

- A. Sand - Fill Type Mississippi River pump sand.: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

#### 2.2 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

#### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

#### 3.3 TRENCHING

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.

- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Stockpile excavated material to be re-used in area designated on site in accordance with Section 312316.
- H. Remove excess excavated material from site.

#### 3.4 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

#### 3.5 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to subgrade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Granular Fill: Place and compact materials in equal continuous layers not exceeding 8 inches compacted depth.
- G. Slope grade away from buildings a minimum 2 inches in 10 ft, unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- H. Correct areas that are over-excavated.
  - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- I. Compaction Density Unless Otherwise Specified or Indicated:
  - 1. Under paving and similar construction: 95 percent of maximum dry density.
  - 2. At below pile supported areas: 85 percent of maximum dry density.
- J. Reshape and re-compact fills subjected to vehicular traffic.

#### 3.6 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D 698 ("standard Proctor"), ASTM D 1557 ("modified Proctor"), or AASHTO T 180.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: 1/2500.

3.8 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION



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## SECTION 312500 - EROSION AND SEDIMENTATION CONTROL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and all general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 WORK TO BE PERFORMED

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including, but not limited to, the following:
  - 1. The work to be performed is shown on the Drawings listed on the contract from. The work shall be performed in accordance with Town of Deerfield Specification, Massachusetts Highway Department (MHD) Standard Specifications for Highways and Bridges, Latest Edition. Said documents are by reference made a part of the contract.
  - 2. Furnish and Install all slope protection, sedimentation and erosion control measures as necessary to retain all erosion and sediments within the construction area, as shown on the Drawings and/or as specified herein, including, but not limited to:
    - a. Provide and maintain hay bales or erosion control silt fence for control of soil runoff on exposed slopes, drainage structures and temporary stockpiles.
    - b. Seeding annual ryegrass, installing erosion control blankets, or temporary mulch as a temporary cover on all exposed slopes and stockpiled topsoil.
    - c. Providing stone construction entrance pads to site and cleaning adjacent roadway surfaces of all accumulated sediment and debris as required or a minimum of once per week.
    - d. Temporary settling basins.
    - e. Erosion Control Blankets (ECB) on all key identified slopes.
    - f. Temporary seeding and lawn stabilization of disturbed areas.
    - g. Dust control.
    - h. Provide and maintain drain inlet Sediment Control Bags at all existing or new catch basins to which runoff from the construction site contributes to.
- B. The following Related Work is specified under the designated Sections:
  - 1. Section 311000 – SITE PREPARATION
  - 2. Section 310000 – EARTHWORK
  - 3. Section 321216 – BITUMINOUS CONCRETE PAVING
  - 4. Section 330000 – SITE UTILITIES

#### 1.3 QUALITY ASSURANCE

- A. Material Standards and Standards of Workmanship: Equal to the Commonwealth of Massachusetts Guidelines for Soil Erosion and Sediment Control and Local Town Requirements.

- B. Requirements specified and noted on drawings are minimum. Provide additional measures as required by the local, State or Federal authorities as a result of Contractor's specific scheduling and Work sequencing, or weather conditions at no additional cost to the Owner.
- C. Qualifications: Engaged firm shall be able to demonstrate experience in the installation of the erosion and sedimentation controls described in the Contract Documents.

#### 1.4 SUBMITTALS

- A. A. Product data for the following:
  - 1. Silt Fence
  - 2. Erosion control blankets.
  - 3. Soil stabilizers.
  - 4. Sediment Control Bags.
  - 5. Fertilizers, seed.
  - 6. Limestone.
  - 7. Chemical preservatives and controls – also confirm that each of the materials proposed to be applied are permitted within the Commonwealth of Massachusetts and the Town of Deerfield.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed, Fertilizer and Lime: Deliver in original sealed, labeled, and undamaged containers, showing weighs, analysis, and name of manufacturer.
- B. Protect materials from deterioration during delivery and while stored at site.

#### 1.6 COORDINATION AND SCHEDULING

- A. General: Sow lawn seed and install all stabilization measures as soon as possible in accordance with the Contractor's schedule.
- B. Weather Limitations: Proceed with lawn development only when existing and forecast weather conditions are suitable for work.

#### 1.7 MAINTENANCE

- A. Begin maintenance of stabilized areas immediately after each area is stabilized and continue until project is accepted.
- B. Maintain and establish all disturbed areas by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth lawn.
  - 1. Replant bare areas.
  - 2. Add new mulch and tackifier in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.

## 1.8 JOB CONDITIONS

- A. Existing Conditions: The contractor shall examine all work that the work of this Section is contingent upon, and report any deficiencies to the Architect. Commencement of the work will be construed to mean complete acceptance by the Contractor of the preparatory work of others. No adjustment will be made for discrepancies brought to the Architect's attention after work has begun.

## 1.9 PROTECTION OF ADJACENT LANDS

- A. The Contractor shall be totally responsible for protection of any lands or properties as may be subject to any effect or by-product of his demolition/construction effort. Special care shall be taken to avoid erosion of fill or cut slopes onto adjacent properties or downstream siltation of diversion of existing surface drainage. Any damage is to be corrected immediately.
- B. Erosions control measures in the locations shown and as detailed and described in the Contract Documents shall be considered minimum requirements and the Contractor shall take whatever other erosion and sedimentation controls steps necessary to accommodate his particular construction procedures.

## 1.10 SCHEDULE PROCEDURE

- A. Erosion control construction shall be done prior to the commencement of demolition, site preparation or earthwork operations. The initial method outlined herein is intended to route all practicable surface water from the excavation area into erosion control facilities. The Contractor shall install any additional protective measures as may be required to control siltation from the site.
- B. The following sequence of construction shall be followed: Revisions shall be only with the approval of the Architect and the responsible municipal governing agency.
  - 1. Place sedimentation control measures along slopes, at catch basins and across swales and outfalls as shown on the Drawings, and where directed by the Architect.
  - 2. Proceed with construction of the remaining items of work in accordance with the approved project sequence and schedule. The contractor shall be responsible for maintaining the integrity of all sediment and erosion control measures for the duration of the Contract.
  - 3. Clean and maintain all sedimentation control components to achieve the intended purpose of both temporary and permanent erosion and sediment control facilities.

## PART 2 - PRODUCTS

### 2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerance.
  - 1. Seed Mixture: 50% Annual Ryegrass; clean with a minimum of 0.50% noxious weed seed; minimum 97% pure with a germination rate minimum of 80%.
  - 2. If seeding occurs after September 15, substitute winter rye for annual rye grass.

- B. Straw Mulch: Provide air-dry, clean, mildew-and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- C. Fiber Mulch: Biodegradable dye-wood cellulose-fiber mulch, nontoxic, free of plant growth or germination-inhibitors, with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth-or germination-inhibitors.

2.2 EROSION-CONTROL MATERIALS

- A. Standard Size Bales of hay of straw, having no loose or decomposed baling twine.
- B. Erosion Control Blanket: C125BN coconut fiber erosion control blanket (100% biodegradable) as manufactured by North American Green or approved Equal. Include biodegradable stakes.
- C. Temporary Mulch: Straw hydromulch or other approved product.
- C. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb. Per sq. yd. (0.5 kg per sq. m) minimum, with 50 to 65 percent open area. Include manufacturer’s recommended steel wire staples, 6 inches (150mm) long.

2.3 SILTATION FENCE

- A. Silt fence shall consist of the following elements:
  1. Fabric for siltation fence shall be a minimum width of 3 feet and conforming to the following criteria:

Fabric Properties	MINIMUM ACCEPTABLE	
	Value	Test Method
Grab Tensile Strength (lbs)	124	ASTM D 4632
Grab Tensile Elongation (%)	15	ASTM D 4632
Mullen Burst Strength (psi)	300	ASTM D 3786
Puncture Strength (lbs)	65	ASTM D 4833
Flow Rate (gal/min/sf)	10	ASTM D 4491
Apparent Opening Size (sieve)	30	ASTM D 4751
Ultraviolet Stability (% strength retained)	70	ASTM D 4355

2. Acceptable fabric materials include “Mirafi Envirofence” by TenCate Mirafi, “Style 2130” by Amoco Fabrics Co., and “LS125-Super Grade” by ACF Environmental, or as approved by the Engineer.
3. Silt fence posts shall be wood or metal. Wood posts shall be a minimum of 1¼ inch by 1¼ inch by 5 feet long hardwood stakes commonly used to support siltation fabric.

Metal posts shall be a minimum of 1 inch diameter and 5 feet long. Posts shall be spaced at a maximum distance of 8 feet on center.

4. Furnish and install suitable nylon cord to secure abutting silt fence posts.

- 2.4 CRUSHED STONE: Conform to MHD, Section M2.01.1, gradation 2".

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION ENTRANCE

- A. Install construction entrances to each project work area and staging area. Location and number of entrances to be modified based on Contractor's specific sequencing of work and as approved by the Architect. Maintain each entrance by regrading and providing additional stone as required to maintain a clean and open surface.
  1. Dimensions: 50' length minimum (typical), 6" depth of crushed stone. Refer to Contract Drawings.
  2. Adjacent pavements are to be kept clean of construction generated sediment and debris. Sweeping shall occur once per week at a minimum or more frequently if so required.

#### 3.2 TEMPORARY SETTLING BASINS

- A. A. Construction temporary settling basins and install erosion control devices washer indicated and around existing and proposed drainage structures in accordance with manufacturer's installation and recommendations. Make any adjustment to location as required by field condition, the Architect, or local Town officials. Install erosion control at limits of grading and topsoil stripping elevations. Do not allow any sediment to enter existing drainage piping systems or wetlands.

#### 3.3 MAINTENANCE

- A. All erosion control measures are to be inspected on a weekly basis and after each rain event resulting in greater than or equal to 0.25 inches per 24-hour period by a designated employee of the General Contractor. The Contractor shall maintain inspection and maintenance logs on site at all times.
- B. Maintain basins and Erosion control devices by restaking and replacing as required. Remove buildup of silt as necessary or as directed by the Architect. Maintain operations until all lawn/planted areas are stabilized and all paving is completed.

#### 3.4 TEMPORARY SEEDING

- A. Seed all exposed slopes and stockpiled topsoil with winter or annual ryegrass at a rate of two (2) pounds/1,000 sq. feet of area. Seeding shall be done immediately after rough grading operations are complete and maintained until finish grading and seeding have begun.

### 3.5 HYDROMULCHING/HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and maximum 10% of fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
  - 1. Mix slurry with nonasphaltic tackifier.
  - 2. Apply slurry uniformly to all area to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb. Per are (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1200 lb. Per acre (11 kg per 100 sq. m).

### 3.6 TEMPORARY EROSION CONTROL FABRIC OR MULCH

- A. Temporary Erosion Control Fabric or Mulch: Immediately upon formation of rough grades, install on all key identified slopes as per manufacturer's recommendations or slopes steeper than one foot vertical to three feet horizontal or any areas and drainage swales which receive concentrated run-off water and areas that are susceptible to erosion as required by the Architect. Overlap joint of erosion control blankets one foot and secure as recommended by the manufacturer. Maintain until permanent vegetative cover is established.

### 3.7 CLEAN UP

- A. Upon stabilization of all disturbed areas and the completing of construction activity, remove all erosion control devices including stone construction entrances and restore surrounding areas to acceptable conditions.

END OF SECTION

## SECTION 321313 – CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and applicable general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes Concrete Paving Including the Following:
  - 1. Driveways.
  - 2. Roadways.
  - 3. Parking lots.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- C. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
  - 1. Exposed Aggregate: 1-lb Sample of each mix.
- D. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and reinforcement accessories.
  - 3. Fiber reinforcement.
  - 4. Admixtures.
  - 5. Curing compounds.
  - 6. Applied finish materials.
  - 7. Bonding agent or epoxy adhesive.
  - 8. Joint fillers.
- B. Field quality-control reports.



## 1.6 QUALITY ASSURANCE

- A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
  - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches.

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- 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

## 1.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
  - 1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
  - 2. Do not use frozen materials or materials containing ice or snow.
  - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

- C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
  - 1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

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- 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

### 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
  - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

### 2.3 STEEL REINFORCEMENT

- A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from galvanized-steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
- H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.

- I. Plain-Steel Wire: ASTM A 1064/A 1064M, galvanized.
- J. Deformed-Steel Wire: ASTM A 1064/A 1064M.
- K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A; coated, plain.
- L. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 plain-steel bars.
- N. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.
- O. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

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- 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A 780/A 780M.

#### 2.4 CONCRETE MATERIALS

- A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
- B. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
  - 1. Portland Cement: ASTM C 150/C 150M, gray or white portland cement Type I, Type II, or Type III.
- C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches, 1 inch, or 3/4 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- D. Air-Entraining Admixture: ASTM C 260/C 260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- F. Water: Potable and complying with ASTM C 94/C 94M.

## 2.5 FIBER REINFORCEMENT

- A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.
- B. Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

## 2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

## 2.7 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
- F. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

## 2.8 STAMPED DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
  1. Size of Stamp: One piece, per New Orleans DPW standards.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.

## 2.9 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
  1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
  2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
  1. Fly Ash or Pozzolan: 25 percent.
  2. Slag Cement: 50 percent.
  3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
  1. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.
  2. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.
  3. Air Content: 5 percent plus or minus 1-1/2 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range, water-reducing admixture in concrete as required for placement and workability.
  2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.
- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- H. Concrete Mixtures: Normal-weight concrete.
1. Compressive Strength (28 Days): 4000 psi.
  2. Maximum W/C Ratio at Point of Placement: 0.50.
  3. Slump Limit: 5 inches, plus or minus 1 inch.
  4. Solar Reflectance Index: Not less than 29.

## 2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94 and ASTM C 1116. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
  2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.

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2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earthwork."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

### 3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
  2. Provide tie bars at sides of paving strips where indicated.
  3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
  5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
  2. Extend joint fillers full width and depth of joint.
  3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
  4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
    - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
  2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
    - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
  3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.



### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- G. Screed paving surface with a straightedge and strike off.
- H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- I. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
  - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
  - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
  - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch-deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.8 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing curing compound or a combination of these as follows:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

### 3.9 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
  - 1. Elevation: 3/4 inch.
  - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  - 3. Surface: Gap below 10-foot-long; unlevelled straightedge not to exceed 1/2 inch.
  - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
  - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
  - 6. Vertical Alignment of Dowels: 1/4 inch.
  - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
  - 8. Joint Spacing: 3 inches.
  - 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
  - 10. Joint Width: Plus 1/8 inch, no minus.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

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- B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
    - 1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
    - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
    - 3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
    - 5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
    - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
      - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
  - C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
  - D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
  - E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  - F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - G. Concrete paving will be considered defective if it does not pass tests and inspections.
  - H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - I. Prepare test and inspection reports.

3.11 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

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## SECTION 321400 – UNIT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Concrete Pavers
  - 2. Mortar Setting Bed Over Concrete Subbase
  - 3. Polymeric Sand Joint Filler

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
  - 1. Concrete Pavers
  - 2. Setting bed materials
  - 3. Polymeric Sand Joint Filler
- B. Sieve Analyses: For sand setting-bed materials, according to ASTM C 136.
- C. Samples for Initial Selection: For the following:
  - 1. Each type of unit paver indicated.
  - 2. Joint materials involving color selection.
- D. Samples for Verification:
  - 1. Full-size units of each type of unit paver indicated. Assemble no fewer than five Samples of each type of unit.
  - 2. Joint Materials
- E. Shop Drawings:
  - 1. Contractor shall submit shop drawings for approval of water jet school emblem prior to fabrication.
    - a. Shop drawings shall indicate size, layout, pattern, materials, and quantities for each type of concrete pavers.
    - b. Shop drawings shall show true profiles, dimensions, joint material, and all necessary information.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
  - 2. Provide a full mockup of paving "school emblem" for approval of Architect prior to installation.
  - 3. Include a mock-up of pavers with anti-gum coating. Provide a 6'x12' application beside a sample of untreated pavers for comparison.
- C. Installer Qualifications:
  - 1. Subcontractor shall submit evidence of skill and not less than five years specialized experience with this product.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. All damaged or otherwise unsuitable material shall be immediately removed from the job site.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

### PART 2 - PRODUCTS

#### 2.1 CONCRETE PAVERS

- A. Concrete Pavers: Precast concrete paving units shall be precast concrete, consisting of Portland cement, aggregate, and color admixture.
- B. Properties:
  - 1. Portland Cement: ASTM C 150, Type III, high early strength.
  - 2. Aggregate: ASTM C 33.
  - 3. Other Constituents: Coloring pigments, integral water repellents, etc., shall be previously established as suitable for use in concrete and either shall conform to ASTM Standards where applicable, or shall be shown by test or experience not to be detrimental to the durability of the concrete.
  - 4. Aggregate for exposed aggregate surface: As selected.
- C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the

following:

1. Wausau Tile, Inc.  
PO Box 1520 Wausau, WI 54402-1520  
9001 Bus. Hwy 51 Rothschild, WI 54474  
Kelly Coleman  
Phone: (601) 941-5983  
Email: Kelly.wausautile@gmail.com  
www.wausautile.com
2. Or Approved Equal.

D. Thickness: 3"

E. Face Size and Shape:

1. Size varies, see contract drawings.

F. Color/Finish: As indicated.

1. Color 1: HEP series in custom color yellow with ground finish.
2. Color 2: HEP series in custom color purple with ground finish.

G. Color Pigment Material Standard: Comply with ASTM C979.

H. Average Compression Strength (C140): 8000 psi (55 MPa) with no individual unit under 7200 psi (50 MPa) per ASTM C140.

I. Average Water Absorption (ASTM C140): 5% with no unit greater than 7%.

J. Freeze/Thaw Resistance (ASTM C1645): 28 freeze-thaw cycles with no greater loss than 225 g/m<sup>2</sup> of paver surface area or no greater loss than 500 g/m<sup>2</sup> of paver surface area after 49 freeze-thaw cycles. Use the lowest freezing temperature (-15o C) in C1645 per the Appendix and zone map in C936 if pavers are subject to deicers. Freeze-thaw testing requirements shall be waived for applications not exposed to freezing conditions.

## 2.2 MORTAR SETTING BED

A. Portland Cement Mortar Mix: Approved mortar mix for Thick Bed (1 1/4 to 2 inches) Mortar Mix. Basis of Design: ANSI A108.1 A, B, or C. May be a Pre-Blended Mortar Mix.

B. Thinset: The use of an ANSI A118.4 Bonding Mortar or better is required. Basis of Design: Custom Building Products

C. Optional Reinforcement: Welded galvanized wire mesh used in thick mortar bed.

D. Water: Clean and free of deleterious acids, alkalies or organic materials.

E. Grout: ANSI A118.7 High Performance Ceramic Tile Grouts. Basis of Design: Custom Building Products Prism Ultimate Performance Grout.

F. Sealant, Back-up and Bond Breaker: As specified by manufacturer.

G. Pressed Pavers to be used in vehicular application must be a minimum of 2 3/4 inches thick.



### 2.3 POLYMERIC SAND JOINT FILLER

- A. Polymeric Sand Mix: To be graded for heavy-traffic and high-humidity areas.
- B. Manufacturers: Product and Manufacturer to be as follows, or approved equal matching detailed performance requirements of product
  - 1. Techniseal HP Next Gel, Polymeric Sand  
Website: [www.techniseal.com](http://www.techniseal.com)
  - 2. Or Approved Equal.
- C. Provide full selection of availably sourced colors per project location for final color selection.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place if applicable.
- C. Ensure that proper drainage has been established in concrete sub-base according to specifications and drawings.

### 3.2 INSTALLATION, GENERAL

- A. Installation shall comply with requirements of applicable building codes and state and local jurisdictions.
- B. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- C. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- D. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Round cut edges to match edge treatment of uncut paver edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- E. Wash surface after sand grout installation. Surface should be clean and free of any residue from sand grout. Do not pressure wash surface.
- F. Mortar Setting Bed Installation:
  - 1. Install per manufacturers recommendation.

### 3.3 PAVER INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Placement Tolerance
- C. Maximum of 1/16 inch (1.6 mm) height variation between adjacent pavers.
- D. Individual pavers shall not vary more than 1/16 inch (1.6 mm) from level across width of the paver.
- E. Paved areas shall not vary more than 1/4 inch (6 mm) from level in a distance of 10 feet (3 m) measured at any location and in any direction.
- F. Joints between pavers to be 1/16 inch. No more than 5% of the joints shall exceed 1/4 inch.

### 3.4 JOINT FILLER MATERIAL

- A. Install per manufacturer's recommendations.

### 3.5 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Resetting pavers: If sand setting bed should shift over time, pavers shall be removed, the sand bed smoothed and/or more sand be added, to return pavement level to initial tolerances.
- C. Cleaning: Remove excess sand grout from exposed paver surfaces; wash and scrub clean. Retain two subparagraphs below if applicable for brick pavers.
  - 1. Use cleaners appropriate for precast concrete finishes and colors. Acid based cleaners will alter finish and color.
  - 2. A 'cement haze' on surface of pavers is not acceptable.
  - 3. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400

## SECTION 321613 – CURBS AND GUTTERS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This work consists of construction and/or installation of a concrete curb, gutter, stone curb, or timber curb.

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 INTEGRAL CONCRETE CURB, STRAIGHT OR CIRCULAR

- A. Integral concrete curb shall be either mountable or barrier curb. Concrete curb and barrier curb shall be constructed monolithically with the same materials, having the same compressive strength and placed and cured in the same manner as the concrete in the roadway slab. The dimensions shall be as shown on standard plans. The overall depth shall be determined by the curb exposure, depth of gutterbottom and roadway slab.
- B. The curb forms shall provide for the dimensions specified and must be set to the established grades.
- C. Premoulded joint filler shall be placed and extended through the entire curb section, at those points where joint filler is used in the roadway slab.

#### 3.2 COMBINED CONCRETE CURB AND GUTTERBOTTOM AND/OR CONCRETE CURB, STRAIGHT OR CIRCULAR

- A. Combined concrete curb and gutterbottom shall be either combined mountable concrete curb and gutterbottom or barrier concrete curb and gutterbottom. Concrete curb shall be either mountable or barrier. The type of concrete curb or concrete curb and gutterbottom to be provided shall be as shown on plans. The forms to be used shall conform to the requirements of these specifications on "FORMS".
- B. The concrete used shall be mixed with the same materials, having the same compressive strength and shall be cured in the same manner as specified for "Reinforced Concrete Roadway Pavements".
- C. Where it is required to construct concrete curb and gutterbottom, the curb and gutterbottom must be poured monolithically.
- D. Undowelled contraction joints shall be placed through the entire width of the concrete curb or curb and gutterbottom, at no greater than fifteen (15') foot intervals. Contraction joints shall be formed by a jointing tool or other acceptable means, having a 2" depth and 1/4" width and filled with silicone sealant or an approved joint sealant.
- E. Dowelled expansion joints shall be placed at intersections, not to exceed three hundred (300') foot intervals, and/or as indicated on the plans.

- F. Pre-moulded joint filler shall be placed through the entire section of the concrete curb or curb and gutterbottom. The concrete curb and gutterbottom shall be reinforced in accordance with the standard plans.
- G. The forms shall provide for the dimensions specified and must be set to the established grades. After placing, concrete shall be worked with a float, in a manner that will thoroughly compact it and provide a surface free from depressions or irregularities of any kind.

### 3.3 CONCRETE GUTTER

- A. Where the concrete gutter is constructed as a part of combined curb and gutterbottom, it shall conform to the requirements of combined curb and gutterbottom. Jointing shall conform to DPW standard specifications subsections C601.06(a) and C601.06(b).
- B. Where the concrete gutter is constructed in conjunction with roadway pavement, it shall, unless otherwise specified or directed, be poured monolithically with, become part of, be laid at the same time, in the same manner and have the same compressive strength as concrete roadway foundation, for such roadway pavements. It shall be of the same width indicated on the plans and of such depth as will be equal to the combined thickness of the roadway foundation and the roadway pavement wearing surface.
- C. The subgrade shall meet the requirements for roadway pavement sub-grade.
- D. Immediately after the concrete has been placed, it shall be tamped, struck off and worked with a wood float in a manner to provide a surface free from irregularities and depressions, bringing the mortar to the top. The surface shall then be broomed or brushed with a soft hand broom in the direction of the flow line of the gutter. Surface joints shall be made by a steel joining tool and premoulded joint filler shall be placed and extended through the entire gutter section at those joints where filler is used in the roadway slab or curb.
- E. Curing the gutter shall be similar to that provided for roadway pavement.

### 3.4 STONE CURB

- A. Stone curb shall either be old stone curb or new stone curb as herein specified.
- B. Old stone curb shall be of suitable quality with well-defined face and top, of the depth not less than prescribed for new curb and not less than three (3') feet in length.
- C. New stone curb shall be best North River Blue Stone or Cabin Creek Blue Stone or Granite or similar stone acceptable to the DPW Director, and shall measure five (5") inches in thickness for the remainder of depth, and in lengths of not less than five (5') feet except for closures. It shall be of such depth as may be indicated on the plans or otherwise specified. The top of the curb shall be peen-hammer dressed, and the face for ten (10") inches below the top pointed, so that there will be no protrusions or depressions measuring more than one-half (1/2") inch from a straightedge laid in any direction parallel to the general surface. All ends shall be squared so as to form close-fitting joints. No drill holes will be permitted to show on any exposed surface. All edges shall be well-defined.
- D. Closures shall not be less than two and one-half (2-1/2') feet in length and must not be placed adjacent to catch basins or over fresh excavations or adjacent to one another. No more than

three (3) such closures will be allowed between any two fixed points such as circular curb for corners, circular curb for driveways or catch basins.

### 3.5 SETTING AND RESETTING STONE CURBS

- A. Stone curb shall be set to lines and grades indicated on plans, or as may be otherwise directed. The subgrade on which the curb base is to be placed shall be excavated and thoroughly tamped by means of a pneumatic tamper.
- B. After the curb has been set to proper line and grade as above, the Contractor shall place under each curb joint, or as close thereto as may be practical, a concrete pier. These piers and concrete base shall be constructed in accordance with dimensions shown on the detail plans, care being taken that the excavation therefore made prior to the pouring of the concrete is evenly cut and as nearly true to the plans as the character of the excavation materials will permit. Care should be taken also, that all loose material is removed from the finished subgrade of the roadway prior to pouring concrete.
- C. One pier shall be provided under each curb joint except in cases where it is impractical to construct one at said point, as where a drain sewer or gas service is directly under the joint and is sufficiently high to prevent the pier being built to the dimensions shown on the plans. In this case, two (2) piers shall be constructed, one (1) on each side of the curb joint and as close thereto as practical.
- D. After setting curb, the excavated area behind same shall be backfilled by tamping and this filling shall be brought to the top of the back of the curb.
- E. Old stone curb of proper quality and dimensions will be relined and reset at its present location when required by the proposal or special specifications, or it shall be removed to other points within the limits of the project, as may be designated by the DPW Director, and there reset.
- F. The ends of all curb, whether new or old, shall be neatly squared so as to form close-fitting joints. Joint filler one-half (1/2") inch in thickness shall be placed adjacent to catch basins and circular curbs when setting stone curbs. All joints in stone curb shall be thoroughly and neatly pointed with mortar. The joints in the precast concrete curbs shall be neatly filled with a joint filler, one-eighth (1/8") inch thick. This joint filler material shall be finished flush with the top and roadway face of the curb.
- G. When stipulated in the Uniform Bid Form and Special Specifications, that curb shall be set in a recess in the concrete foundation of the pavement, then this shall be done only after the concrete has become thoroughly hardened. The recess shall be cleared of all foreign matter and on its bottom surface there shall be placed a bed of stiff mortar, varying from one-quarter (1/4") inch to three quarter (3/4") inch in thickness and averaging one-half (1/2") inch in thickness depending on the irregularities in the bottom of the stone curb, or the concrete roadway foundation. When the curb stones have been so set, the recess on both sides of the curb shall be filled from top to bottom with liquid mortar. Compensation for providing the recess and for filling same with mortar after the curb has been set shall be included in the price per linear foot bid in the proposal for curb.
- H. Cuts of proper dimensions, executed in a neat and workmanlike manner shall be made where directed and where required in both new and old curb for drain pipe or gas pipe where required under the curb for connections. No additional compensation shall be made for such cuts.

- I. No extra compensation will be allowed for removing obstructions, gallery or shed posts, etc. that may be encountered in setting new or old curb, nor will any extra compensation be allowed for shoring or reinforcing sheds or galleries that may be necessary.

### 3.6 CIRCULAR STONE CURB

- A. Circular stone curb shall be granite, free of stratification and excess of mica, flint and feldspar. The entire top shall be peen-hammer dressed, and the face of eight (8") inches from the top and the back for four (4") inches from the top of the curb shall be neatly pointed. All edges shall be well defined. The stone shall have squared and neatly finished ends, so as to form close-fitting joints.
- B. Circular stone curb shall be of the radius indicated on plans or as otherwise specified. When the radius is two (2') feet or less, the circular curb shall be in one (1) piece; where the radius is more than two (2') feet, and not more than four (4') feet, the circular curb shall be in two (2) pieces; where the radius is more than four (4') feet, and not more than six (6') feet, the circular curb shall be in three (3) pieces; where the radius is more than six (6') feet, and not more than eight (8') feet, the circular curb shall be in four (4) pieces; where the radius is more than eight (8) feet, and not more than ten (10') feet, the circular curb shall be in five (5) pieces; and where the radius is more than ten (10') feet, and not more than twelve (12') feet, the circular curb shall be in six (6) pieces.
- C. Circular stone curb shall be twelve (12") inches in depth, five (5") inches in width at both ends, and of such widths intermediate to the ends as shown on plans.

### 3.7 SETTING CIRCULAR STONE CURB

- A. Circular curb shall be of the quality and dimensions hereinbefore prescribed for circular curb.
- B. All joints in circular stone curb shall be thoroughly and neatly jointed with mortar and such amount of lamp black added as may be necessary to make the color of the mortar correspond with the color of the stone immediately after it has been set and while it is to correct line and grade.
- C. Circular curb shall be placed on a concrete foundation four (4") inches in thickness mixed in proportion of one (1) part cement to three (3) parts fine aggregate to six (6) parts coarse aggregate.

### 3.8 TIMBER CURB

- A. Timber curb shall be placed on the lines and at the grades as shown on the drawings or as furnished by the DPW Director, and shall be of the dimensions indicated on the plans and herein described.
- B. The face of curbs shall be set either barrier or with a batter as may be designated.
- C. Timber curb shall be formed of either creosoted No. 1 Common Pine, twelve (12 lb.) pound treatment, or treated No. 1 Common Pine .6 lb/cf of CCA, anchors, braces, sills and boards as shown on plans and herein described.
- D. Posts shall measure four (4") inches by four (4") inches and generally the length shall be three

- E. (3) times the depth of the finished curb measured on its surface. Posts shall generally be spaced six (6') foot centers apart.
- F. Boards shall be three (3") inches thick and not less than eight (8") inches wide and generally not less than sixteen (16') feet long. They shall be laid horizontal with close-fitting sides and end joints. Joints shall be broken so that boards alongside of each other shall not break joints on the same posts.
- G. At such points as may be designated, cuts of proper dimensions, executed in a neat and workmanlike manner shall be made for drain pipe connections and for the proper construction of foot bridges. No direct compensation shall be made for such cuts.

### 3.9 MEASUREMENT

- A. The length of curb, gutter, and curb and gutterbottom will be established by measurements of the actual curb, gutter and curb and gutterbottom in place and no allowance will be made for waste due to closures or other causes.
- B. Circular curb shall be measured at the top outer face.
- C. Timber curb will be measured by the number of board feet (MFBM) including board and posts.
- D. Joint materials, rebars, concrete base and piers for stone curb or resetting existing curb shall not be measured for payment.
- E. Excavation for reconstruction of curb and gutter bottom only, and excavation for setting and resetting stone curbs in rehabilitating projects shall not be measured for payment.

END OF SECTION

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## SECTION 321623 – SIDEWALKS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. This work consists of construction of sidewalks and related access features

#### 1.2 RELATED REQUIREMENTS

- A. Sidewalks and ramps shall comply with the most current regulations for Titles II and III of the Americans with Disabilities Act of 1990 (ADA) and applicable accessibility standards published by the Department of Justice (the 2010 ADA Standards for Accessible Design, "2010 Standards", or later).

### PART 2 - PRODUCTS (Not Used)

### PART 3 - EXECUTION

#### 3.1 SIDEWALKS AND RAMP ACCESSIBILITY

- A. An ADA curb ramp is a short ramp cutting through a curb or built up to it to provide an accessible path of travel.
  - 1. On a curb ramp, the running slope is the slope in the direction of pedestrian travel on the ramp run and must be 8.33 percent (1:12) or less. Where provided, curb ramp flares shall not be steeper than 1:10.
  - 2. On a curb ramp, the cross slope is the slope perpendicular to [across] the direction of pedestrian travel on the ramp run and the cross slope of the ramp run itself may not exceed 2 percent (1:50).
  - 3. The ramp, or ramp run, must be at least 48 inches wide, not including the flared sides. The ramp run must have detectable warnings – i.e., dome-shaped bumps – that extend the full width and depth of the ramp.
  - 4. Transitions from the ramp to the walkway, gutter, and street must be flush (level) and free of abrupt level changes. The gutter must have a slope of no more than 5 percent (1:20) toward the ramp.
  - 5. Landings shall be provided at the tops of curb ramps. The minimum landing clear length shall be 48 inches. The landing clear width shall be at least as wide as the curb ramp, excluding flared sides, leading to the landing.
  - 6. Diagonal or corner type curb ramps with returned curbs or other well-defined edges shall have the edges parallel to the direction of pedestrian flow. The bottom of diagonal curb ramps shall have a clear space of 48 inches minimum outside active traffic lanes of the roadway. Diagonal curb ramps provided at marked crossings shall provide the 48 inches minimum clear space within the markings. Diagonal curb ramps with flared sides shall have a segment of curb 24 inches long minimum, located on each side of the curb ramp and within the marked crossing.
- B. Raised islands in crossings shall be cut through level with the street or have curb ramps at both sides. Each curb ramp shall have a level area 48 inches long minimum by 48 inches wide minimum at the top of the curb ramp in the part of the island intersected by the crossings. Each 48 inch minimum by 48 inch minimum area shall be oriented so that the 48 inch minimum

length is in the direction of the running slope of the curb ramp it serves. The 48 inch minimum by 48 inch minimum areas and the accessible route shall be permitted to overlap.

- C. The running slope of sidewalks must be 5 percent (1:20) or less. The cross slope of sidewalks must be 2 percent (1:50) or less. The clear width of sidewalks shall be at least 48 inches and a sidewalk with a clear width of less than 60 inches shall provide passing spaces at intervals of 200 feet maximum. If the longitudinal slope of the sidewalk exceeds 1:20, it is considered a ramp and a level landing must be provided for every 30-inch change in elevation.

### 3.2 PORTLAND CEMENT CONCRETE SIDEWALK OR BANQUETTE PAVEMENT

- A. Portland cement concrete sidewalk or banquette pavement shall be of such widths and fixed at such elevations as may be stipulated in the proposal and Special Specifications, or may be otherwise designated by the DPW Director. They shall consist of a one course Portland cement concrete pavement four (4") inches in thickness.
- B. The concrete shall have a minimum compressive strength of three thousand (3,000) psi. at twenty-eight (28) days. The minimum cement content shall be five and one-half (5-1/2) bags per cubic yard of concrete. The maximum water content, including free water in the aggregate, shall not be greater than six (6) gallons per bag of cement. The consistency of concrete shall be such as to have a slump of from two (2") inches to four (4") inches.
  - 1. Sidewalks or banquettes shall be reinforced with 6 X 6 – W2.9 X W2.9 wire mesh weighing forty-two (42) pounds per hundred square feet.
- C. In preparing the subgrade on which the Portland cement concrete sidewalk or banquette pavement will be placed, all soft and spongy places shall be removed and all depressions filled with suitable materials which shall be thoroughly compacted in layers not exceeding six (6") inches in thickness. The subgrade shall be thoroughly tamped until it is brought to a firm, unyielding surface. It shall have a slope in conformity with the slope of the finished surface of the Portland cement concrete sidewalk or banquette pavement.
- D. When the Portland cement concrete sidewalk or banquette pavement is to be constructed over an old path composed of gravel or cinder, the old path shall be entirely loosened, the material spread for the full width of the subgrade and compacted as specified.
- E. All fills shall be made in a manner satisfactory to the DPW Director. The use of muck, quicksand, soft clay, spongy or perishable material is prohibited. The top of all fills shall extend at least two (2') feet beyond the sidewalk or banquette pavement on each side and the sides shall have a maximum slope not greater than one (1) vertical to one and one-half (1-1/2) horizontal before any Portland cement concrete sidewalk or banquette pavement will be allowed to be placed thereon.
- F. Concrete shall be of the strength and consistency herein before described. The method of mixing and placing shall be in conformance with the requirements for DPW Specifications Subsections C601.20 and C601.21, Portland cement concrete pavement. Concrete that does not flush readily shall be removed immediately from the grade and not re-used, except that the coarse aggregate can be salvaged by washing.
- G. After mixing, the concrete shall be handled rapidly and the successive batches deposited in a continuous operation completing individual sections to the required depth and width. The forms shall be filled and the concrete struck off and tamped. The method of placing the various sections shall be such as to produce a straight clean joint between them so as to make each

section an independent unit. If dirt, dust or other foreign substances collect on the surface, they shall be removed before the trowelling is started.

- H. After the concrete has been tamped in accordance with subsection 2 (e), it will be brought to the established grade by means of a strike board, and it will then be worked with a wood float in a manner which will thoroughly compact it and provide a surface free from depressions or irregularities of any kind. Excessive working shall be avoided. In no case shall dry cement and sand be sprinkled on the surface. The surface edges of all slabs shall be rounded to a radius of one-half (1/2") inch.
  - I. Portland cement concrete sidewalk or banquette pavement shall be divided into blocks of such dimensions, by means of a joiner or grooves, as shown on the Standard Plans or as the DPW Director may designate. Weakened planes shall be formed by a jointing tool or other acceptable means. Weakened planes shall extend into concrete for at least one-quarter (1/4") inch of the depth and shall be approximately one-eighth (1/8") inch wide. Spacing of weakened planes shall be equal to the width of the sidewalk. Transverse expansion joints shall be made at intervals of about ninety (90') feet and constructed in accordance with the standard plans.
  - J. All expansion joints shall be carefully made so as to be truly perpendicular to the surface of the sidewalk or banquette pavement and at right angles to the edge of same. The surface of the concrete adjacent to expansion joints shall be finished with a wood float, which is divided through the center and which will permit finishing on both sides of the joint at the same time. An expansion joint shall also be provided adjacent to solid walls of masonry, behind curbs, at intersections and at footlaps. Where posts or poles fall within the limit of the sidewalk or banquette pavement, an expansion joint not less than one-half (1/2") inch in width shall be placed around said posts or poles and filled with joint filler. In the case of expansion joints adjacent to masonry walls, at footlaps and around posts or poles, the joint filler shall not extend above the surfaces of the sidewalk or banquette pavement and any excess filler that so protrudes shall be cut off and made flush with the sidewalk or banquette pavement.
  - K. As soon as the finished work has hardened sufficiently to prevent damage, the surface of the walk shall be covered with curing compound. The freshly finished work shall be protected from hot sun and drying winds until it can be covered as above specified. Curing by application of chemicals or some other method of curing may be used upon the approval of the DPW Director. The concrete surface must not be damaged or pitted by raindrops and the Contractor shall provide and use, where necessary, sufficient tarpaulins to completely cover all sections that have been placed within the preceding twelve (12) hours. The Contractor shall erect and maintain suitable barriers to protect the walk from traffic, and any section damaged from traffic or other causes, shall be repaired or replaced by the Contractor at his own expense, in a manner satisfactory to the DPW Director. The walk shall not be opened to traffic until the prescribed curing period has expired.
  - L. Portland cement concrete sidewalk or banquette pavement at intersections, including ramps for the handicapped, shall be six (6") inches thick and placed as above specified.
- 3.3 BRICK SIDEWALK OR BANQUETTE PAVEMENT
- A. Brick sidewalk or banquette pavement shall be of such width, grades or elevations as shown on plans or as may be designated by the DPW Director and laid in the manner herein described and as shown on the standard plan.

- B. The surface of the earth upon which the brick sidewalk or banquette pavement will rest shall be first graded and tamped and otherwise prepared as specified for Portland cement concrete sidewalk or banquette pavement.
- C. Five (5") inches of reinforced concrete foundation having a compressive strength of not less than three thousand (3,000) psi. in twenty-eight (28) days shall be poured and tamped. The brick shall be laid on a prepared subgrade, a minimum of a three-eighths (3/8") inch setting bed which is composed of one (1) part cement to three (3) parts sand. Bricks shall be in close contact with each other and thoroughly tamped. After tamping, they shall be thoroughly sprinkled and all joints shall at once be completely filled with grout formed of one (1) part Portland cement concrete to three (3) parts sand. Thereafter, clean, sharp sand shall be evenly spread on the surface to a thickness of approximately one-half (1/2") inch. When the grout has been in place for seventy-two (72) hours or longer, this sand shall be removed and may be re-used at the option of the Contractor.
- D. After completion, the brick sidewalk or banquette pavement shall be closed to traffic and not opened until so directed by the DPW Director. The Contractor will be required to barricade and protect the walk in every way as prescribed and required for Portland cement concrete sidewalk or banquette pavement.
- E. Brick sidewalk or banquette pavement will be paid for by the square yard, at the price bid in the proposal for that item, which price shall include grading and all the materials, reinforced concrete foundation, labor, tools, equipment and service employees used in completing the brick sidewalk or banquette pavement in place as herein described.

#### 3.4 RELAYING SIDEWALK OR BANQUETTE PAVEMENT

- A. All sidewalk or banquette pavement relaid shall conform to the requirements herein fixed for new sidewalk or banquette pavement. Where old bricks are not suitable for relaying, they shall be replaced by new brick.
- B. When Portland cement concrete sidewalk or banquette pavement is unavoidably disturbed in executing the work embraced by the specifications, the limits of the area proposed to be disturbed or removed shall be sharply defined by the Contractor with concrete saw made lines and then carefully removed along said lines. Should the surface fracture along irregular lines, a straight line shall be struck and the edge made true. When other sidewalk or banquette pavement is unavoidably disturbed, they shall be restored by the Contractor to the same conditions in which they were before they disturbed them, and for such work, he shall be compensated at the prices bid in the proposal for relaying sidewalk or banquette pavement; no compensation shall be allowed for relaying sidewalk or banquette pavement that has been unnecessarily disturbed.
- C. Relaying sidewalk or banquette pavement shall be paid for by the square yard at the price bid in the proposal for those items, which price shall include all materials, labor, tools, equipment and services employed in taking up the sidewalk or banquette pavement and restoring them to the same condition in which they were before being disturbed, including the grouting of old brick. Exception is made in the case of Portland cement concrete sidewalk or banquette pavement, which price shall include all material, labor, tools, equipment and services employed in taking up and relaying them.

3.5 MINIMUM SIDEWALK OR BANQUETTE TREATMENT WITHIN THE DOWNTOWN DEVELOPMENT DISTRICT

- A. This will be in accordance with Section 146-193 of the City Code.

3.6 MINIMUM SIDEWALK OR BANQUETTE TREATMENT WITHIN THE VIEUX CARRE:

- A. This will be in accordance with Section 146-194 of the City Code.

3.7 TILE STREET NAMES:

A. LETTERS OR NUMBERS FOR TILE STREET NAMES:

- 1. Letters or numbers for tile street names shall be hard, tough, durable, porcelain tile or other material satisfactory to the DPW Director. The letters or numbers shall be block type on tile not less than five and one-half (5-1/2") inches, nor greater than six (6") inches high. The letters or numbers shall not be less than five (5") inches high, of blue or willow green in color, on a white background. Letter or numbers for tile street names shall be installed and oriented so that they may be read by pedestrians approaching the intersection where they are located.

B. RESETTING TILE STREET NAMES:

- 1. Existing tile street names shall be salvaged intact by saw-cutting the name out of the concrete in which the tiles are imbedded. The saw-cut shall be located two (2") inches away from the name's perimeter and will extend through the depth of the concrete, usually four (4") inches. The salvaged street name tile shall be reset in the fresh concrete of the sidewalk intersection, flush with the level of the sidewalk and clean of any cement residue.

END OF SECTION

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## SECTION 329200 – TURFGRASSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Sodding.
  - 2. Coarse Sand.
  - 3. Turf Renovation.
- B. Related Sections:
  - 1. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
  - 2. Division 32 Section "Plants" for border edgings.

#### 1.3 DEFINITIONS

- A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- F. Planting Area: Areas to be planted.
- G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

- H. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
  - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
- B. Samples for Verification: For each of the following:
  - 1. Turfgrass Sod: One (1) sample delivered to the site for review. Maintain approved sample on-site as a standard for comparison.
  - 2. Coarse Sand.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  - 1. Manufacturer's certified analysis of standard products.
  - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For Planting Soil & Coarse Sand.
- F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turfgrass during a calendar year. Submit before start of required maintenance periods.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
  - 1. Experience: Five (5) years' experience as a Landscape Horticulturalist as well as five (5) years experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
  - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 3. Personnel Certifications: Installer's field supervisor shall have certification as a Landscape Horticulturalist licensed by the state.
  - 4. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing



indicated and that specializes in types of tests to be performed. Louisiana State University Division of Agriculture Cooperative Extension Service shall be the preferred testing facility.

- C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  - 1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  - 2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three (3) representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  - 3. Report suitability of tested soil for plant growth.
    - a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problems materials are present, provide additional recommendations for corrective action.
- D. Preinstallation Conference: Conduct conference at Project site or other location approved by Architect. Contractor to notify Architect of meeting time/location at least seven (7) days in advance.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.
- C. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new turf by field measurements before proceeding with turfgrass work.
- B. Planting Restrictions: Plant during the following period. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
  - 1. Planting Season: September 15<sup>th</sup> - April 15<sup>th</sup>.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

## 1.8 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of land-scape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods.
  - 1. Sodded Turf: Twelve (12) months from the date of Substantial Completion.
- B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.1 TURFGRASS SOD

- A. Turfgrass Sod: Approved, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod grown on sand substrate of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Bermuda Grass (*Cynodon dactylon*): See Plans.

### 2.2 COARSE SAND

- A. ASTM C-33 Fine Aggregate, with a Fines Modulus Index of 2.8 and 3.2.
- B. Sands shall be clean, sharp, natural sands free of limestone, shale and slate particles. Sand PH shall be lower than 7.0.

- C. Provide the following particle size distribution:

Sieve	Percent Passing
3/8" (9.5mm)	100
No 4 (4.75mm)	95-100
No 8 (2.36mm)	80-100
No 16(1.18mm)	50-85
No30 (.60mm)	25-60
No50 (.30mm)	10-30
No100 (.15mm)	2-10

### 2.3 INORGANIC SOIL AMENDMENTS

- A. Add necessary inorganic soil amendments as required by the soil test.

### 2.4 FERTILIZERS

- A. All fertilizer shall be a commercial balanced formula with at least 25% organic material and shall conform to applicable State fertilizer laws. It shall be a slow-release formula, "Osmocote", or equal and shall be used as specified by manufacturer. Fertilizer, unless otherwise specified, shall be delivered mixed as specified, in standard size, unopened containers, showing weight, analysis and name of manufacturer.

### 2.5 PLANTING SOILS

- A. Planting Soil: Existing, in-place surface soil within pH range of 5 - 7, topdressed with a 2" layer of clean sand. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with soil amendments as recommended by the Louisiana State University Division of Agriculture Cooperative Extension Service or other approved lab.

### 2.6 PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
  - 1. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply fertilizer directly to subgrade before loosening.
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    - b. Mix lime with dry soil before mixing fertilizer.
  - 2. Spread pump sand to a depth of 2 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if subgrade is frozen, muddy, or excessively wet.

- C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
  - 1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
  - 2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
  - 3. Spread pump sand to a depth of 2 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if subgrade is frozen, muddy, or excessively wet.
  - 4. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
  - 5. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- F. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Use rolls of sod for large areas.
- C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across angle of slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
  - 3. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.
  - 4. Sodded areas are to be top dressed using coarse sand filling seam joints.

### 3.5 TURF RENOVATION

- A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
  2. Install new planting soil as required.
  3. The sod shall be of the same type and variety as the existing grass.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Water newly planted areas and keep moist until new turf is established.

### 3.6 TURF MAINTENANCE

- A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
  2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Turf Watering: Contractor shall irrigate as required to maintain vigorous and healthy turf growth. Overwatering or flooding shall not be allowed. The Contractor shall furnish any water to ensure adequate irrigation during maintenance period.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Bermuda grass to a height of 1.0 to 2.0 inches.
- D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

### 3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Landscape Architect:
1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

2. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

### 3.8 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

### 3.9 CLEAN UP PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment-period.

END OF SECTION 329200

## SECTION 329300 – PLANTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Plants.
  - 2. Planting Soil.
  - 3. Mulch.
  - 4. Landscape Edging.
  - 5. Tree Stabilization.
  - 6. Slow-Release Watering Bags.
  - 7. Round River Rock

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project
  - 3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
  - 4. Soils: Include source of materials and photographs of each constituent material.
  - 5. Mulch.
  - 6. Tree Stabilization.
  - 7. Metal Restraint.
  - 8. Round River Rock.
- B. Product Submittals: For the following product:
  - 1. Round River Rock: Submit a 1-gallon sample of round river rock to architect for approval.
  - 2. Soil: Submit a 1-gallon sample of each soil type after mixing to architect for approval.



3. Soil Test Reports: Provide test reports from qualified independent testing agency for each soil mix:
  - a. Provide separate, clearly labeled, tests for each material and/or each source of materials if more than one for the same material.
  - b. Testing agency shall clearly indicate compliance, or lack thereof, with requirements of this specification.
  - c. Recommendations for amendments if applicable.
- C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Warranty: Written warranty and maintenance procedures.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
  1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
  3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  4. Pesticide Applicator, if applicable: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
  1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent

defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
  1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, rhizomes, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  2. Do not remove container-grown stock from containers before time of planting.
  3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
  - 1. Notify Architect no fewer than seven days in advance of proposed interruption of each service or utility.
  - 2. Do not proceed with interruption of services or utilities without Architect's written permission.
- C. Planting Restrictions: Plant during the following period unless temporary irrigation is installed, calibrated, operated, and maintained by the contractor for a period of 6 months from planting date.
  - 1. Planting Season: October 15 – April 1
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

## 1.7 WARRANTY

- A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of tree stabilization.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Periods from Date of Substantial Completion of Project.
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  - 3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting seasons.
    - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at the end of warranty period.
    - c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

- d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

## 1.8 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  1. Maintenance Period: The Contractor shall maintain for 12 months from the date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
  1. Maintenance Period: The Contractor shall maintain for 12 months from the date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; with lichen, moss or other living substances growing on the bark; with cuts in the bark, whether healed or fresh; or with stem girdling roots will be rejected.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

## 2.2 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones one half inch (1/2") or larger in any dimension and other extraneous materials harmful to plant growth. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes. Test soil for pH levels after mixing. Soil source to be approved in writing by Landscape Architect.
1. Mix the following quantities of materials to produce Planting Soil:
    - a. 1/3 Existing Site Topsoil or Manufactured Topsoil.
    - b. 1/3 Black Bark Mulch.
    - c. 1/3 Clean Coarse Sand.
    - d. Weight of 8-8-8 Slow-Release Fertilizer per 1,000 SF: 8lbs.
  2. Mix the following quantities of materials to produce Lawn Soil:
    - a. 50% Existing Site Topsoil or Manufactured Topsoil.
    - b. 50% Clean Coarse Sand.

## 2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:
1. Type: Pine needles in bales with long needles, not crushed or chopped.
  2. Depth: Three (3) inches.
  3. Cypress Mulch will not be accepted.
- B. Mulch must not be placed within three (3) inches of a tree trunk.
- C. The Contractor shall be responsible for the replacement of mulch during the one-year warranty and maintenance period.

## 2.4 LANDSCAPE EDGING

- A. Product: Standard Commercial Grade Landscape Edging.
1. Series: Clean Line XL
  2. Edging Size: 3/16" x 6"
  3. Finish: Mill Finish
  4. Stakes: 18" Aluminum Stake
- B. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Permaloc; E-mail: [info@permaloc.com](mailto:info@permaloc.com); Tel: (616) 399-9600; Website: [www.permaloc.com](http://www.permaloc.com)

## 2.5 TREE STABILIZATION SYSTEM

### A. Tree Stabilization

1. Metal Stakes: Metal Stakes: 6' metal "T" post stakes, green. Or approved equivalent. Provide three (3) stakes per tree or as otherwise indicated in the Drawings.
2. Guying straps: ¾" wide "ArborTie" flat polypropylene strap with break strength of 900lbs (min). Color: dark green or black. As manufactured by, or approved equal
  - a. Manufacturer: Deep Root Partners, L.P., 81 Langton St., San Francisco, CA 94103, Phone: 800-458-7668, Website: [www.deeproot.com](http://www.deeproot.com) or approved equal.

## 2.6 SLOW RELEASE WATERING BAGS

A. Product: Treegator (Original), Slow Release Watering Bag, 20 gallons.

B. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Treegator; 153 Mosswood Blvd; Youngsville NC, 27596; Tel: (866) 873-3428, Website: [www.treegator.com](http://www.treegator.com)

## 2.7 ROUND RIVER ROCK

A. Round natural stone shall consist of inert materials that are hard, durable, and with, with stone free from surface coatings and deleterious materials.

1. Size: 4" – 6"
2. Color: Beige/Neutral color mix

B. Manufacturer: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Jim Stone Co., 13751 Florida Blvd, Baton Rouge, LA 70819. Tel: 225-272-5707, Website: <http://jimstoneco.com>
2. Or Approved Equal.

## PART 3 - EXECUTION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Spread planting soil to a depth of 12 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
  2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.

3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

### 3.5 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above finish grades.
  1. Use planting soil for backfill.
  2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.

### 3.6 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Do not apply pruning paint to wounds.

### 3.7 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in drawings in even rows with triangular spacing.
- B. Use planting soil for backfill.



- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.8 PLANTING AREA MULCHING

- A. Mulch surfaces of planting areas and other areas indicated only to a depth of 3”.
- B. Trees without the specified depth of mulch at the end of the Warranty and Maintenance period shall be rejected.

### 3.9 MAINTENANCE

- A. Trees and Shrubs: Contractor shall irrigate as required to maintain vigorous and healthy plant growth. Overwatering or flooding shall not be allowed. The Contractor shall furnish any water to ensure adequate irrigation.
- B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- C. Stake Removal: At the end of the Warranty and Maintenance period, the Contractor shall be responsible for removing any above ground stakes from all trees planted under this contract.

### 3.10 CLEANUP PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion of Project remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.11 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

## SECTION 331600 – UNDERGROUND STORM STORAGE TANKS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the owner's and OSHA requirements.
2. Provide and install R-Tank<sup>LD</sup> system (hereafter called R-Tank) and all related products including fill materials, geotextiles, geogrids, inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.
3. Provide and construct the cover of the R-Tank system including; stone backfill, structural fill cover, and pavement section as specified.
4. Protect R-Tank system from construction traffic after installation until completion of all construction activity in the installation area.

#### 1.2 QUALITY CONTROL

- A. All materials shall be manufactured in ISO certified facilities.
- B. Installation Contractor shall demonstrate the following experience:
  1. A minimum of three R-Tank or equivalent projects completed within 2 years; and,
  2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.
  3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.
- C. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.
- D. Contractor must have manufacturer's representative available for site review if requested by Owner.

#### 1.3 SUBMITTALS

- A. Submit proposed R-Tank layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.
- B. Submit manufacturer's product data, including compressive strength and unit weight.
- C. Submit manufacturer's installation instructions.

- D. Submit R-Tank sample for review. Reviewed and accepted samples will be returned to the Contractor.
- E. Submit material certificates for geotextile, geogrid, base course and backfill materials.
- F. Submit required experience and personnel requirements as specified in Section 1.03.
- G. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening. Review package should include third party reviewed performance data that meets or exceeds criteria in Table 2.01 B.

#### 1.4 DELIVERY, STORAGE, AND HANDLEING

- A. Protect R-Tank and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds two weeks. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.
- B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.
- C. Cold weather:
  - 1. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.
  - 2. Do not use frozen materials or materials mixed or coated with ice or frost.
  - 3. Do not build on frozen ground or wet, saturated or muddy subgrade.

#### 1.5 PREINSTALLATION CONFERENCE

- A. Prior to the start of the installation, a preinstallation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, the R-Tank installation contractor, and the manufacturer's representative.

#### 1.6 PROJECT CONDITIONS

- A. Coordinate installation for the R-Tank system with other on-site activities to eliminate all non-installation related construction traffic over the completed R-Tank system. No loads heavier than the design loads shall be allowed over the system, and in no case shall loads higher than a standard AASHTO HS20 (or HS25, depending on design criteria) load be allowed on the system at any time.
- B. Protect adjacent work from damage during R-Tank system installation.
- C. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the R-Tank system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.
- D. Contractor is responsible for any damage to the system during construction.

PART 2 - PRODUCTS

2.1 R-TANK UNITS

- A. R -Tank<sup>LD</sup> - Injection molded plastic cells stacked to form a 90% void modular structure of pre-designed height (custom for each project).
- B. R-Tank<sup>LD</sup> units shall meet the following Physical & Chemical Characteristics:

PROPERTY	DESCRIPTION	R-Tank <sup>LD</sup> VALUE
Void Area	Volume available for water storage	95%
Surface Void Area	Percentage of exterior available for infiltration	90%
Compressive Strength	ASTM D 2412 / ASTM F 2418	30 psi
Minimum Cover	Cover required to support HS-25 loads	12"
Maximum Cover	Maximum allowable cover depth	36"
Unit Weight	Weight of plastic per cubic foot of tank	3.29 lbs / cf
Service Temperature	Safe temperature range for use	-14 to 167° F

- C. Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234  
 (T): 800-448-3636; (F): 804-743-7779 [www.acfenvironmental.com](http://www.acfenvironmental.com)

2.2 GEOSYTHETICS

- A. Geotextile. A geotextile envelope is required to prevent backfill material from entering the R-Tank modules.
  - 1. Standard Application: The standard geotextile shall be a minimum 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).
  - 2. Infiltration Applications: When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a woven monofilament (ACF M200 or equivalent) shall be used.
- B. Geogrid: When required by project plans, install geogrid (ACF BX12 or equivalent) to reinforce backfill above the R-Tank system.

2.3 BACKFILL AND COVER MATERIALS

- A. Bedding Materials: Stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the R-Tank system (3" minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.
- B. Side and Top Backfill:
  - 1. Deep Applications (> 12" total cover): Free draining stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used adjacent to (12" minimum) and above (for the first 12") the R-Tank system. Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
  - 2. Shallow Applications (< 12" total cover): Materials listed in section 2.03 B1 above may be used adjacent to the modules. Top backfill must be well graded aggregate (angular and smaller than 0.75" in diameter) or soil (GW or SW as classified by the Unified Soil Classification System). Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
- C. Additional Cover Materials: Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

## 2.4 OTHER MATERIALS

- A. Utility Marker: Install metallic tape at corners of R-Tank system to mark the area for future utility detection.

## PART 3 - EXECUTION

### 3.1 LAYOUT AND EXCAVATION

- A. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 2 feet greater than R-Tank dimensions in each direction allowing for installation of geotextile filter fabric, R-Tank modules, and free draining backfill materials.
- B. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.
- C. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.

- D. Base of the excavation shall be uniform, level, and free of lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.
  - 1. Standard Applications: Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.
  - 2. Infiltration Applications: Subgrade shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration applications.
  
- E. Unsuitable Soils or Conditions: All questions about the base of the excavation shall be directed to the owner's engineer, who will approve the subgrade conditions prior to placement of stone. The owner's engineer shall determine the required bearing capacity of the R-Tank subgrade; however in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.
  - 1. If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.
  - 2. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.
  - 3. Do not start installation of the R-Tank system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

### 3.2 PREPARATION OF BASE

- A. Place a thin layer (3" unless otherwise specified) of bedding material (Section 2.03 A), over the subgrade to establish a level working platform for the R-Tank modules. Level to within 1/2" (+/- 1/4") or as shown on the plans. Native subgrade soils or other materials may be used if determined to meet the requirements of 2.03 A and are accepted by the owner's engineer.
  - 1. Standard Applications: Static roll or otherwise compact bedding materials until they are firm and unyielding.
  - 2. Infiltration Applications: Bedding materials shall be prepared in accordance with the contract documents.
  
- B. Outline the footprint of the R-Tank system on the excavation floor using spray paint or chalk line to ensure a 12" perimeter is available around the R-Tank system for proper installation and compaction of backfill.

### 3.3 INSTALLATION

- A. Where a geotextile wrap is specified on the stone base, cut strips to length and install in excavation, removing wrinkles so material lays flat. Overlap geotextile a minimum 12" or as recommended by manufacturer.
  
- B. Where an impervious liner (for containment) is specified, install the liner per manufacturer's recommendations and the contract documents. The R-Tank units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.
  
- C. Install R-Tank<sup>LD</sup> Units in layers in accordance with the design drawings. R-Tank<sup>LD</sup> pieces on each layer should be connected to all other pieces on that layer. Layers should stack on top of each preceding layer evenly. No vertical connection between layers is required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the R-

Tank system. The panels are to be oriented as per the design drawing (19.68" x 23.62") with required depth as shown on plans.

- D. Wrap the R-Tank top and sides in specified geotextile. Cut strips of geotextile so that it will cover the sides and top, encapsulating the entire system to prevent backfill entry into the system. Overlap geotextile 12" or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.
- E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (buted up to the R-Tank) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the R-Tank units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against R-Tank system.
- F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 10' of each inlet & outlet connection, and with a maximum spacing of one maintenance port for every 2,500 square feet. Install all ports as noted in the R-Tank Installation Guide.
- G. If required, install ventilation pipes and vents as specified on drawings to provide ventilation for proper hydraulic performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90 degree elbow with PVC pipe into a landscaped area with 'U' bend or venting bollard to inhibit the ingress of debris. A ground level concrete or steel cover can be used.

### 3.4 BACKFILLING

- A. Backfill and fill with recommended materials as follows:
  - 1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 12". Each lift shall be placed around the entire perimeter such that each lift is no more than 24" higher than the side backfill along any other location on the perimeter of the R-Tank system. No fill shall be placed over top of tanks until the side backfill has been completed.
  - 2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density or until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even when "self-compacting" backfill materials are selected, a walk behind vibratory compactor must be used.
  - 3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and R-Tank units.
  - 4. No compaction equipment is permissible to operate directly on the R-Tank modules.
  - 5. Top Backfill:
    - a. Deep Applications (> 12" total cover): Install a 12" (or as shown on plans) lift of freely draining material (Section 2.03 B1) over the R-Tank<sup>LD</sup> Units, maintaining 12" between equipment tracks and R-Tank System. Lightly compact using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons)



- may be used. Roller must remain in static mode until a minimum of 24" of cover has been placed over the modules. Sheep foot rollers should not be used.
- b. Shallow Applications (< 12" total cover): Install top backfill (Section 2.03 B2) in accordance with plans using an LGP skid steer or dozer (rubber tracks preferred). Lightly compact using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons) may be used in static mode only.
  6. If required, install a geogrid as shown on plans. Geogrid shall extend a minimum of 3 feet beyond the limits of the excavation wall.
  7. Following placement and compaction of the initial cover, subsequent lifts of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the R-Tank system. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 12" across the footprint of the R-Tank system. Do not exceed maximum cover depths listed in Table 2.01 B.
  8. Place additional layers of geotextile and/or geogrid at elevations as specified in the design details. Each layer of geosynthetic reinforcement placed above the R-Tank system shall extend a minimum of 3 feet beyond the limits of the excavation wall.
- B. Only low pressure tire or track vehicles shall be operated over the R-Tank system during construction. No machinery should drive on top of the tank until a minimum of 18" of backfill and compaction is achieved. Dump Trucks and Pans shall not be operated within the R-Tank system footprint at any time. Where necessary the heavy equipment should unload in an area adjacent to the R-Tank system and the material should be moved over the system with tracked equipment.
  - C. Ensure that all unrelated construction traffic is kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the R-Tank system until the final design section has been constructed (including pavement).
  - D. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.
  - E. Backfill depth over R-Tank system must be within the limitations shown in the table in Section 2.01 B. If the total backfill depth does not comply with this table, contact engineer or manufacturer's representative for assistance.

END OF SECTION 331600

## SECTION 334100 – STORM UTILITY DRAINAGE PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. The work of this section includes, but is not limited to, the following:
  - 1. Perforated HDPE Underdrain and Distribution Pipe
  - 2. Overflow Drain Basin with Dome Grate
  - 3. Aggregate Drainage System
  - 4. Geotextile Filter Fabric

#### 1.2 SUBMITTALS

- A. Submit certificates from manufacturers of the following items certifying that the following materials comply with the requirements specified in this Section:
  - 1. Perforated HDPE Underdrain Pipe
  - 2. Aggregate Drainage System
  - 3. Geotextile Filter Fabric
- B. Submit, for testing, to a certified testing laboratory, one quart representative sample of each porous granular material proposed as backfill around the subdrains
  - 1. Submit the sample in a clean, sturdy sealed container or bag that shall not permit loss or contamination of any kind of the material.
  - 2. Clearly label the container or bag of the sample with: Contract location, title and number; the name of the material supplied; and location of the source.
  - 3. The Landscape Architect will approve or disapprove the proposed material within 21 days after receipt of the laboratory certification.
  - 4. Do not deliver material to the construction site from any source until the Landscape Architect has approved the material from that source.
- C. Shop Drawings: Submit shop drawings showing layout, inverts, and product components, including accessories for drainage piping and all drainage connections to composites.
- D. Submit catalog cuts of pipes and geotextile for the Landscape Architect's approval.

#### 1.3 QUALITY ASSURANCE

- A. Qualifications:
  - 1. Installer Qualifications: Installer experienced to perform work of this type, who has specialized in the installation of work similar to that required for this project who can comply with manufacturer's warranty requirements, and who is an authorized applicator as determined by drainage manufacturer.
  - 2. Manufacturer Qualifications: Manufacturer with a minimum of 10 years experience in underdrainage systems, capable of providing technical support in the application of the drainage system.

- B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.
- C. The Landscape Architect will visually inspect pipe when delivered to the construction site. Damaged material or material not meeting the requirements of this Section shall be removed from the construction site and replaced at no cost to the Owner.
- D. The Landscape Architect may inspect pipe at the place of manufacture.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Schedule deliveries to avoid construction delays but minimize jobsite storage.
- B. Comply with the manufacturer's instructions for unloading, storing and moving all materials.
- C. Care shall be taken when storing pipe and appurtenances so as not to damage any public or private property. Any property so damaged shall be repaired at the Contractor's expense and at the approval of the Landscape Architect and Construction Manager.
- D. Store Aggregate Drainage System Pipe sections under tarp to protect from sunlight, when time from delivery to installation exceeds one week.

#### 1.5 PROJECT CONDITIONS/ SITE CONDITIONS

- A. When the pipe is bedded in a drainage layer the pipe shall be installed at the same time as the drainage layer.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
  - 1. Manufacturer's Warranty:
    - a. Extended 15 year Drainage Warranty.

### PART 2 - PRODUCTS

#### 2.1 UNDERDRAIN AND DISTRIBUTION PIPE

The following two items would be acceptable for the use of the landscape underdrain piping.

- A. Provide corrugated single wall heavy duty polyethylene (HDPE) (100% post-consumer recycled) resins pipe, conforming to ASTM F405 and F667.
  - 1. NPS 6 and Smaller: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.

2. Size as shown on Contract Drawings.
3. Perforations shall occur only on the underside of the pipe.
4. Provide perforated pipe under planted areas and non-perforated pipe under pavements and at connections into drainage structures.
5. Pipe Accessories: Cleanouts, couplings, end caps, tees, wyes, end plugs shall be heavy duty polyethylene resins, conforming to ASTM F405 and F667
6. Perforated High Density Polyethylene (HDPE) Pipe shall be from one of the following manufacturers or an approved equivalent:
  - a. Advanced Drainage Systems, Inc.  
4640 Trueman Blvd.  
Hilliard, OH 43026  
Phone: 800-821-6710
  - b. JM Eagle, Inc.  
5200 West Century Boulevard  
Los Angeles, CA 90045  
Phone: 800-621-4404
  - c. Crumpler Plastic Pipe, Inc.  
PO Box 2068, Highway 24 West;  
Roseboro, NC 28382  
Phone: 800-334-5071
  - d. or approved equal.

- B. Provide perforated pipe (PVC, SDR 35), conforming to ASTM D2729.
1. Size as shown on Contract Drawings.
  2. Perforations shall occur only on the underside of the pipe.
  3. Three perforation rows 60 degree – 60 degree circumferential hole spacing.
  4. 5" to 6" longitudinal hole spacing.
  5. .5" hole diameter.
  6. Pipe Accessories: Couplings, end caps, tees, wyes, end plugs shall be heavy duty polyethylene resins, conforming to ASTM D2729.

## 2.2 OVERFLOW DRAIN BASIN WITH DOME GRATE

- A. High Density Polyethylene (HDPE) drain structure with integrated ductile iron grate per ASTM A536 Grade 70-50-05 to match basin outer diameter.
1. Acceptable manufacturers include but are not limited to:
    - a. Advanced Drainage Systems, Inc. 4640 Trueman Blvd. Hilliard, OH 43026  
Phone: 800-821-6710
    - b. or approved equal.

## 2.3 GEOTEXTILE FILTER FABRIC

- A. Landscape Drainage Filter Fabric:
1. A drainage-type non-woven geotextile fabric shall be used as a separation layer to prevent the surrounding in-situ subgrade soil from migrating into the underdrainage system. The geotextile is used to line the entire trench excavation prior to placement of any crushed stone and underdrainage piping. The permeability of the drainage fabric shall be a minimum of 120 gal/min/sq.ft.

2. Drainage filter fabric shall meet the following Minimum Average Roll Value (MARV) specifications across the weave:

Property	Requirement	Requirement
Grab Tensile Strength	ASTM D4632	90 lbs. min.
Grab Tensile Elongation	ASTM D4632	25% max.
Trapezoidal Tear Strength	ASTM D4533	40 lb. min
Mullen Burst Strength	ASTM D3786	130 psi. min.
Puncture Strength	ASTM D4833	60 lbs. min.
UV Resistance	ASTM D-4335	70% at 500 hrs min.
Apparent Opening	ASTM-D-4751	40-80 US Sieve
Permeability	ASTM D-4491	120 gal/min/ft.2 min.

3. Acceptable manufacturers include but are not limited to:
- a. TenCate, Inc.  
 365 South Holland Drive  
 Pendergrass, GA 30567  
 Phone: 706-693-2226  
 Phone: 888-795-0808
  - b. Carthage Mills  
 4243 Hunt Road  
 Cincinnati, OH 45242  
 Phone: 513-794-1600  
 Phone: 800-543-4430
  - c. Or Approved Equal.

2.4 DRAINAGE GRAVEL

- A. Underdrainage Pipe Filtration Gravel:
1. Washed aggregate for use as backfill with Perforated HDPE shall be as shown on the Contract Drawings.
  2. The perforated underdrainage pipes shall require a minimum 6 inch gravel filtration encasement to protect the pipe from siltation.
  3. In order to best match the sand particle size and allow for laminar inflow of water, an AASHTO gravel size of #7 or #78 is required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions: Verify that the substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and in compliance with the Drawings. Do not proceed with drainage installation until substrate conditions are acceptable for compliance with manufacturer's warranty requirements.
- B. Notify Construction Manager and Landscape Architect if unacceptable conditions are present and wait to proceed with work until the condition has been corrected. Do not proceed in uncertainty.

### 3.2 PREPARATION

- A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during installation operations.
- B. Substrate Cleaning: Clean substrate that is to receive drainage. Remove loose debris and other harmful contaminants that will affect performance of drainage composite.

### 3.3 UNDERDRAINAGE SYSTEM INSTALLATION

- A. Pipe Installation - General
  1. Prior to the start of construction, the method for control of alignment and grade shall be submitted for approval. The method shall be a laser system or grade board setup, to establish a reference grade and alignment control directly above or within the pipe. Use of other equipment may be substituted if in the opinion of the Landscape Architect, the alternate system produces equivalent accuracy. Pipe invert elevations shall be checked at intervals no greater than 25 feet and shall be constructed to the lines and grades as shown on the Drawings.
  2. Coordinate Installation of solid pipe under pavements that may need to be in place before the planting soils and under drainage system are installed.
  3. All lines shall be positively pitched. Take extreme care to eliminate sags or drops in pipeline that would obstruct or slow down the flow of water.
  4. Connect under drainage system to storm drainage structures. Pipe connection shall be fully embedded into the drainage structure and shall be sealed with a non-shrink gROUT. Coordinate connections to not delay work.
  5. Use manufacturer's connection system for connecting different drainage pipe/systems to each other.
  6. Use fittings for branch connections and bends. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
  7. Inspect each pipe and fitting before and after installation; remove those found defective from site and replace with new. Provide proper facilities for lowering sections of pipe into trenches.
  8. For plastic pipe installations, remove all rocks or other hard objects larger than 1 1/2 inches in size from the area within 12 inches of the pipe.
  9. For plastic pipe installations, do not use blocking or mounding to bring the pipe to grade. Conform to the applicable requirements of ASTM D 2321.
  10. Pipe beds in bedding material shall be rounded to accommodate the bottom quadrant of the pipe and to provide full support and uniform bearing for the entire length of the pipe barrel.

11. Take precautions to ensure that the interior of the pipeline remains clean during pipe jointing.
12. Make up the pipe joints in accordance with the manufacturer's instructions.
13. Care shall be taken not to damage or displace installed pipes during construction.
14. Where pipe is damaged or displaced, take remedial measures as directed by the Landscape Architect, at no additional cost to the Owner.
15. Close all opening in the pipeline temporarily with watertight wood blocks or bulkheads when pipelaying is stopped at the conclusion of the work period or interrupted for any reason.
16. Do not cover pipe until the Landscape Architect has approved the installation.
17. Coordinate connection of discharge with the site utility contractor.
18. HDPE Pipe shall be used at the base of planted areas, bio-swales, and as shown on the drawings. Provide vertical clean out pipes for all systems at a minimum of 250' o.c. Review locations of clean out with Landscape Architect as work proceeds.

B. Aggregate Drainage System Installation

1. Install beginning at the outlet point and work upstream.
2. Use internal couplings provided by the manufacturer to connect pipe sections together.
3. To cut pipe to lengths other than ten-foot intervals, mark the mesh where cut needs to be made and carefully make a cross-sectional cut in the mesh to access Polystyrene Aggregate. Remove and set aside sufficient aggregate to expose the pipe and to re-connect the mesh to the pipe. Using an appropriate connector such as a nylon wire tie, re-attach the mesh to the pipe, making sure remaining aggregate is properly contained. Cut the exposed polyethylene pipe to the measured length. Dispose of remaining aggregate properly.
4. At the end of the work day all upstream open ends of pipe shall be covered or plugged to prevent intrusion of dirt, debris and foreign objects.
5. Aggregate Drainage System shall be used on all site walls and as shown on the Drawings.

3.4 CLEANING AND PROTECTION

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions before owner's acceptance. Remove construction debris from project site and legally dispose of debris.
- B. Take extreme care to protect planting soils installed by others.
- C. Protection: Protect installed products finished surfaces from damage during construction.

END OF SECTION 334100