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# PROJECT MANUAL FOR



**1520 Germantown Street  
Dayton, Ohio 45417**

## **100% Construction Document Submission**

**TC PROJECT NO: 82-A-21  
DATE: March 31, 2023**



**SECTION 00 0110  
TABLE OF CONTENTS**

**DRAWINGS**

A001	TITLE SHEET
A002	CODE DATA
A003	LIFE SAFETY PLANS
A004	OHFA DACF FORM
A005	OHFA DACF FORM
A006	OHFA DACF FORM

**CIVIL**

C001	SITE SURVEY
C100	SITE CLEARING PLAN
C200	SITE UTILITY PLAN
C300	SITE PAVING PLAN
C301	SITE LAYOUT PLAN
C400	STORM SEWER AND GRADING PLAN
C500	EROSION CONTROL NARRATIVE
C501	EROSION CONTROL DETAILS
C600	SITE DETAILS
C601	SITE DETAILS
C602	SITE DETAILS

**LANDSCAPE**

L100	LANDSCAPE PLAN
L101	DETAILS

**ARCHITECTURAL**

A101	FIRST FLOOR PLAN
A101A	FIRST FLOOR DIMENSIONAL PLAN
A102	SECOND FLOOR PLAN
A102A	SECOND FLOOR DIMENSIONAL PLAN
A103	THIRD FLOOR PLAN
A103A	THIRD FLOOR DIMENSIONAL PLAN
A104	FIRST FLOOR RCP
A105	SECOND FLOOR RCP
A106	THIRD FLOOR RCP
A107	ROOF PLAN
A201	EXTERIOR ELEVATIONS
A202	EXTERIOR ELEVATIONS
A203	BUILDING SECTION
A301	ELEVATOR SECTION
A302	STAIR PLANS & DETAILS
A303	STAIR SECTIONS
A401	WALL SECTIONS
A402	WALL SECTION & TOWER DETAILS
A403	WALL SECTION & DETAILS
A404	CANOPY & AIR SEAL DETAILS
A501	ONE BEDROOM PLANS
A502	TWO BEDROOM PLANS
A503	THREE BEDROOM PLANS
A504	INTERIOR ELEVATIONS
A505	INTERIOR ELEVATIONS
A506	ENLARGED COMMON AREA PLANS
A507	ENLARGED COMMON AREA PLANS

A508	INTERIOR ELEVATIONS
A601	PARTITION TYPES
A602	DOOR & WINDOW SCHEDULE
A603	WINDOW SCHEDULE & DETAILS
A604	DOOR DETAILS
A605	UL ASSEMBLIES
A606	UL ASSEMBLIES
A607	UL ASSEMBLIES
A608	UL ASSEMBLIES
A609	UL ASSEMBLIES
A610	UL ASSEMBLIES
A611	UL ASSEMBLIES
A612	UL ASSEMBLIES
A613	UL ASSEMBLIES
A701	FINISH SCHEDULES
A702	FINISH LEGEND
A703	FIRST FLOOR FINISH PLAN
A704	SECOND FLOOR FINISH PLAN
A705	THIRD FLOOR FINISH PLAN
A801	INTERIOR SIGNAGE PLANS
A802	INTERIOR SIGNAGE PLANS
A803	MONUMENT SIGN

### **STRUCTURAL**

S000	GENERAL NOTES
S001	SPECIAL INSPECTIONS
S100	FOUNDATION PLAN
S101	2ND FLOOR FRAMING PLAN
S102	3RD FLOOR FRAMING PLAN
S103	ROOF FRAMING PLAN
S200	FOUNDATION SECTIONS
S300	FRAMING DETAILS
S301	FRAMING DETAILS
S302	FRAMING DETAILS
S303	DETAILS AND SCHEDULES

### **PLUMBING**

P001	PLBG NOTES, LEGENDS, SCHEDULES
P101	FIRST FLOOR PLAN – PLUMBING
P102	SECOND FLOOR PLAN – PLUMBING
P103	THIRD FLOOR PLAN – PLUMBING
P201	TYPICAL ONE BEDROOM PLANS
P202	TYPICAL TWO BEDROOM PLANS
P203	TYPICAL THREE BEDROOM PLANS
P301	PLUMBING DETAILS
P302	PLUMBING DETAILS
P401	PLUMBING ISOMETRICS

### **FIRE PROTECTION**

FS001	FIRE SUPP. NOTES, LEGENDS
FS101	FIRST FLOOR PLAN - FIRE SUPP.
FS102	SECOND FLOOR PLAN - FIRE SUPP.
FS103	THIRD FLOOR PLAN - FIRE SUPP.

## **MECHANICAL**

H001	HVAC GEN NOTES AND LEGENDS
H101	FIRST FLOOR PLAN – HVAC
H102	SECOND FLOOR PLAN – HVAC
H103	THIRD FLOOR PLAN – HVAC
H201	TYPICAL ONE BEDROOM PLANS
H202	TYPICAL TWO BEDROOM PLANS
H203	TYPICAL THREE BEDROOM PLANS
H301	HVAC SCHEDULES
H401	DETAILS, TEMP. CONTROLS – HVAC
H402	HVAC DETAILS

## **ELECTRICAL**

E001	NOTES & LEGENDS – ELECTRICAL
ES01	SITE PLAN – ELECTRICAL
E101	LIGHTING - FIRST FLOOR - ELEC.
E102	LIGHTING - SECOND FLOOR - ELEC.
E103	LIGHTING - THIRD FLOOR - ELEC.
E201	POWER - FIRST FLOOR - ELEC.
E202	POWER - SECOND FLOOR - ELEC.
E203	POWER - THIRD FLOOR - ELEC.
E301	SYSTEMS - FIRST FLOOR - ELEC.
E302	SYSTEMS - SECOND FLOOR - ELEC.
E303	SYSTEMS - THIRD FLOOR - ELEC.
E401	TYPICAL ONE BEDROOM - ELEC.
E402	TYPICAL TWO BEDROOM - ELEC.
E403	TYPICAL THIRD BEDROOM - ELEC.
E501	POWER RISER DIAGRAMS - ELEC.
E601	SCHEDULES – ELECTRICAL
E602	SCHEDULES – ELECTRICAL
E701	DETAILS – ELECTRICAL
E702	DETAILS – ELECTRICAL
E703	DETAILS - ELECTRICAL
E704	DETAILS – ELECTRICAL

## **SPECIFICATIONS**

### **DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS**

00 0110	Table of Contents
00 7315	Retainage Requirements

### **DIVISION 01 – GENERAL REQUIREMENTS**

01 1000	Summary
01 2000	Price and Payment Procedures
01 2500	Contract Modification Procedures
01 3000	Administrative Requirements Submittal Stamp Example
01 3216	Construction Progress Schedule
01 3300	Submittal Procedures
01 4000	Quality Requirements
01 4126	Permit Requirements
01 4200	Reference Standards
01 4216	Definitions
01 5000	Temporary Facilities and Controls
01 5713	Temporary Erosion and Sediment Control

- 01 5721 Indoor Air Quality Controls
- 01 6000 Product Requirements
- 01 6116 Volatile Organic Compound (VOC) Content Restrictions
- 01 7000 Execution and Closeout Requirements
- 01 7419 Construction Waste Management and Disposal
- 01 7800 Closeout Submittals
- 01 7900 Demonstration and Training
- 01 8113 Sustainable Design Requirements
- Home Energy Rating System (HERS) Analysis

**DIVISION 02 – EXISTING CONDITIONS – NOT USED**

**DIVISION 03 – CONCRETE**

- 03 2000 Concrete Reinforcing
- 03 3000 Cast-In-Place Concrete
- 03 5400 Cementitious Underlayment

**DIVISION 04 – MASONRY**

- 04 2200 Concrete Unit Masonry
- 04 2201 Clay Brick Masonry
- 04 7200 Cast Stone Masonry

**DIVISION 05 – METALS – NOT USED**

**DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES**

- 06 0500 Common Work Results for Wood, Plastic, and Composites
- 06 1000 Rough Carpentry
- 06 1600 Sheathing
- 06 1715 Engineered Structural Wood
- 06 1753 Shop-Fabricated Wood Trusses
- 06 2000 Finish Carpentry
- 06 4023 Interior Architectural Woodwork
- 06 6640 Decorative Columns

**DIVISION 07 – THERMAL AND MOISTURE PROTECTION**

- 07 0500 Common Work Results for Thermal and Moisture Protection
- 07 2100 Thermal Insulation
- 07 2500 Weather Barriers
- 07 3113 Asphalt Shingles
- 07 4600 Vinyl Siding
- 07 4646 Fiber Cement Siding
- 07 6200 Sheet Metal Flashing and Trim
- 07 7123 Manufactured Gutters and Downspouts
- 07 8400 Firestopping
- 07 9200 Joint Sealants

**DIVISION 08 – OPENINGS**

- 08 0500 Common Work Results for Openings
- 08 1113 Hollow Metal Doors and Frames
- 08 1416 Flush Wood Doors
- 08 1614 Molded Panel Interior Doors
- 08 3113 Access Doors and Frames
- 08 3313 Coiling Counter Doors
- 08 4313 Aluminum-Framed Storefronts
- 08 5313 Vinyl Windows
- 08 7100 Door Hardware

- 08 7101 Door Hardware Schedule
- 08 7113 Automatic Door Operators
- 08 8000 Glazing
- 08 9100 Louvers

**DIVISION 09 – FINISHES**

- 09 0500 Common Work Results for Finishes
- 09 0561 Common Work Results for Flooring Preparation
- 09 2116 Gypsum Board Assemblies
- 09 3000 Tiling
- 09 6500 Resilient Flooring
- 09 6813 Tile Carpeting
- 09 8100 Acoustical Insulation
- 09 9000 Painting and Coating
- 09 9000.1 Painting Schedule

**DIVISION 10 – SPECIALTIES**

- 10 0500 Common Work Results for Specialties
- 10 1400 Signage
- 10 2601 Door, Wall & Corner Guards
- 10 2800 Toilet, Bath, and Laundry Accessories
- 10 4400 Fire Extinguishers
- 10 5523 Mail Boxes
- 10 5623 Wire Storage Shelving

**DIVISION 11 – EQUIPMENT**

- 11 3100 Residential Appliances
- 11 8227 Waste Compactors

**DIVISION 12 – FURNISHINGS**

- 12 2100 Window Blinds
- 12 3530 Residential Casework
- 12 3661 Quartz Countertops

**DIVISION 13 – SPECIAL CONSTRUCTION – NOT USED**

**DIVISION 14 – CONVEYING EQUIPMENT**

- 14 2000 Passenger Elevations
- 14 9100 Facility Chutes

**DIVISION 21 – FIRE PROTECTION**

- 21 0500 Common Work Results for Fire Suppression
- 21 0501 Basic Mechanical Materials and Methods for Fire Protection
- 21 0517 Sleeves and Sleeve Seals for Fire Suppression
- 21 0518 Escutcheons for Fire Suppression Piping
- 21 0519 Meters and Gages for Fire Suppression Piping
- 21 0529 Hangers and Supports for Fire Suppression Piping and Equipment
- 21 0553 Identification for Fire Suppression Piping and Equipment
- 21 1119 Fire Department Connections
- 21 1313 Wet-Pipe Sprinkler Systems

**DIVISION 22 – PLUMBING**

- 22 0500 Common Work Results for Plumbing
- 22 0513 Common Electrical Requirements for Plumbing
- 22 0519 Meters and Gages for Plumbing Piping
- 22 0523 General Duty Valves and Strainers

- 22 0529 Hangers and Supports for Plumbing Piping and Equipment
- 22 0553 Identification for Plumbing Piping and Equipment
- 22 0700 Pipe Insulation
- 22 1120 Plumbing Piping
- 22 1123.21 Inline, Domestic Water Pumps
- 22 1429 Sump Pumps
- 22 3300 Electric, Domestic Water Heaters
- 22 4400 Plumbing Fixtures

**DIVISION 23 – HVAC**

- 23 0500 Common Work Results for HVAC
- 23 0513 Common Motor Requirements for HVAC Equipment
- 23 0529 Hangers and Supports for HVAC Piping and Equipment
- 23 0593 Testing, Adjusting & Balancing for HVAC
- 23 0713 Duct Insulation
- 23 2300 Refrigerant Piping
- 23 3113 Metal Ducts
- 23 3300 Air Duct Accessories
- 23 3423 HVAC Power Ventilators
- 23 3713 Diffusers, Registers, and Grilles
- 23 5400 Furnaces
- 23 8113.11 Packaged Terminal Air-Conditioners, Through-Wall Units
- 23 8119 Environmental Conditioning Units
- 23 8239.19 Wall and Ceiling Unit Heaters

**DIVISION 26 – ELECTRICAL**

- 26 0500 Common Work Results for Electrical
- 26 0501 Common Electrical Materials and Methods
- 26 0519 Low-Voltage Electrical Power Conductors and Cables
- 26 0526 Grounding and Bonding for Electrical Systems
- 26 0529 Hangers and Supports for Electrical Systems
- 26 0533 Raceways and Boxes for Electrical Systems
- 26 0543 Underground Ducts and Raceways for Electrical Systems
- 26 0544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
- 26 0553 Identification for Electrical Systems
- 26 0573.13 Short-Circuit Studies
- 26 0573.16 Coordination Studies
- 26 0573.19 Arc-Flash Hazard Analysis
- 26 2316 Utility Service Connection Cabinet
- 26 2416 Panelboards
- 26 2726 Wiring Devices
- 26 2813 Fuses
- 26 2816 Enclosed Switches
- 26 2913 Manual Motor Controllers
- 26 4313 Surge Protection for Low-Voltage Electrical Power Circuits
- 26 5119 LED Interior Lighting
- 26 5213 Emergency and Exit Lighting
- 26 5613 Lighting Poles and Standards
- 26 5619 LED Exterior Lighting

**DIVISION 28 – ELECTRONIC SAFETY AND SECURITY**

- 28 4621 Addressable Fire Alarm Systems

**DIVISION 31 – EARTHWORK**

- 31 1000 Site Clearing
- 31 2000 Earthwork for Utilities



**DIVISION 32 – EXTERIOR IMPROVEMENTS**

32 1216	Hot-Mix Asphalt Paving
32 1313	Concrete Pavement
32 1360	Pavement Joint Sealants
32 3113	Chain Link Fences and Gates
32 9200	Lawns and Grasses

**DIVISION 33 – UTILITIES**

33 3100	Domestic Water- Private Fire Service Mains
33 3200	Natural Gas Service Piping
33 4100	Storm Sewerage
33 5100	Sanitary Sewerage

**END OF TABLE OF CONTENTS**

**SECTION 00 7315  
RETAINAGE REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section supplements the General Conditions of the Contract for Construction.

**1.2 RETAINAGE REQUIREMENTS**

- A. The Owner will pay ninety percent (90%) of the amount due the Contractor on account of progress payments until Substantial Completion.
- B. The ten percent (10%) retained will be paid in full to the Contractor when the work is one hundred percent complete as determined by the Architect and accepted by the Owner.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

**END OF SECTION 00 7315**

## SECTION 01 1000 SUMMARY

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including the Conditions of the Contract and Division 01 Specification Sections, apply to all Specification sections.

#### **1.2 PROJECT**

- A. Project Name: Germantown Crossing
- B. Project Location: 1520 Germantown Street, Dayton, Ohio 45417
- C. Owner's Name: Germantown Crossing LLC
- D. Architect's Name: TC Architects.

#### **1.3 CONTRACT DESCRIPTION**

- A. Contract Type: A single prime contract based on a Stipulated Price

#### **1.4 PROJECT DESCRIPTION**

- A. The Work of the Project is a 3 story family apartment building, including but not limited to:
  - 1. Licenses, permits, inspections, and fees required by authorities having jurisdiction
  - 2. Temporary facilities and controls necessary for coordination and management of the site and work.
  - 3. Concrete work
  - 4. Masonry work
  - 5. Structural wood framing
  - 6. Carpentry, cabinetry, casework
  - 7. Insulation sealants, firestopping and other forms of thermal and moisture protection.
  - 8. Frames, doors, hardware, and glazing
  - 9. Drywall and acoustical work
  - 10. Finishes
  - 11. Specialties and accessories
  - 12. Fire protection
  - 13. Plumbing
  - 14. HVAC
  - 15. Electrical work
  - 16. Safety and security
  - 17. Site work, including paving work and other designated items
  - 18. Installation of Owner-Furnished items.
  - 19. Coordination with separate contractors hired by the Owner.
  - 20. Quality control and testing.
  - 21. Final cleaning.
  - 22. Demonstration and training.
  - 23. Final closeout procedures.

#### **1.5 SPECIAL PROJECT PROCEDURES**

- A. Radon Testing: Prior to commencement of the Work, the Contractor shall engage a qualified testing agency to determine the presence of radon. If the test results indicate radon levels for the site exceed the EPA recommended limits, engage a qualified engineer to design and install a suitable radon mitigation system. Submit shop drawings and technical data for the system for review prior to installation.
- B. Sustainable Design: The Project shall comply with selected LEED Certified requirements for sustainability. Refer to Section 01 8113 – Sustainable Design Requirements for detailed requirements.

#### **1.6 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Time Restrictions:

1. Limit conduct of noise-producing exterior work to the hours of 8:00 a.m. and 5:00 p.m. of as agreed upon by Owner.

**1.7 WORK SEQUENCE**

- A. Coordinate construction schedule and operations with Owner.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION - NOT USED**

**END OF SECTION 01 1000**

**SECTION 01 2000  
PRICE AND PAYMENT PROCEDURES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

**1.2 SCHEDULE OF VALUES**

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values within 15 days after date of Owner-Contractor Agreement.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification Section. Identify General Conditions, building permit fee, and performance and payment bond.
- E. Update schedule to list approved Change Orders, with each Application For Payment.

**1.3 APPLICATIONS FOR PROGRESS PAYMENTS**

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
  - 1. Item Number.
  - 2. Description of work.
  - 3. Scheduled Values.
  - 4. Previous Applications.
  - 5. Work in Place and Stored Materials under this Application.
  - 6. Authorized Change Orders.
  - 7. Total Completed and Stored to Date of Application.
  - 8. Percentage of Completion.
  - 9. Balance to Finish.
  - 10. Retainage.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- H. Confirm number of copies of each Application for Payment required.

**1.4 MODIFICATION PROCEDURES**

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a Construction Change Directive signed by the Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
  - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
  - 2. The Contractor shall promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a Proposal Request that includes a detailed description of a proposed change with supplementary or revised drawings

and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within the number of days stated in the request.

- D. Contractor may propose a change by submitting a Request for Change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
  - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
  - 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
  - 3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
  - 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- F. Substantiation of Costs: Provide full information required for evaluation.
  - 1. On request, provide following data:
    - a. Quantities of products, labor, and equipment.
    - b. Taxes, insurance, and bonds.
    - c. Overhead and profit.
    - d. Justification for any change in Contract Time.
    - e. Credit for deletions from Contract, similarly documented.
  - 2. Support each claim for additional costs with additional information:
    - a. Origin and date of claim.
    - b. Dates and times work was performed, and by whom.
    - c. Time records and wage rates paid.
    - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
  - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- J. Promptly enter changes in Project Record Documents.

#### **1.5 APPLICATION FOR FINAL PAYMENT**

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
  - 1. All closeout procedures specified in Section 01 7800.

#### **PART 2 - PRODUCTS - NOT USED**

#### **PART 3 - EXECUTION - NOT USED**

**END OF SECTION 01 2000**

**SECTION 01 2500  
CONTRACT MODIFICATION PROCEDURES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications. Contract modification procedures include the following:
1. Architect's supplemental instructions.
  2. Proposal requests.
  3. Contractor initiated requests for changes in the Contract.
  4. Construction change directives.
  5. Change Orders.

**1.2 ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS**

- A. The Architect will issue written authorization to execute minor changes in the Work not requiring adjustment to the Contract Sum or Contract Time. Notify the Architect within ten days of receipt of supplemental instructions if supplemental instructions will result in changes in Contract Sum or Time.

**1.3 PROPOSAL REQUESTS**

- A. Proposal Requests: The Architect will solicit proposals from the Contractor for changes in the Work that will require adjustment to the Contract Sum or Contract Time.
1. Form: *AIA G709 Proposal Request*.
  2. Proposal requests are issued for information only. Do not stop work in progress or execute the proposed change without a fully executed Change Order.
  3. Within the number of days designated on the Proposal Request, submit a detailed estimate of cost necessary, including but not limited to material, labor, overhead and profit, to execute the change to the Architect for the Owner's review.
    - a. List quantities of products required and unit costs, with the total amount of purchases to be made.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. State how the proposed change in the Work will affect the Contract Time.
    - d. State how the proposed change may affect the work of other Contracts or future work.

**1.4 CONTRACTOR INITIATED REQUESTS FOR CHANGE IN THE CONTRACT**

- A. When latent or unforeseen conditions require modifications to the Contract, the Contractor shall submit a request for a change in the Contract to the Architect. Requests shall include the following:
1. Justification for the proposed change, including description of Project conditions.
  2. Description of the proposed change.
  3. Proposed change in the Contract Sum, including detailed cost analysis, including, but not limited to material, labor, overhead and profit.
  4. Proposed change in the Contract Time.
  5. Comply with requirements in Section 01 6000 - Product Requirements if the proposed change requires substitution of a specified product or system.

**1.5 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: The Construction Change Directive issued by the Architect instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Form: AIA Form G714 Construction Change Director.
- B. Documentation: Maintain detailed records of time and material expended for work required. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

**1.6 CHANGE ORDERS**

- A. Following Owner's approval of a proposal issued by the Contractor, the Architect will issue a Change Order for signatures of the Owner and the Contractor.

**PART 2 - PRODUCTS (Not Applicable)**

**PART 3 - EXECUTION (Not Applicable)**

**END OF SECTION 01 2500**



**SECTION 01 3000  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 - COLLABORATION SOFTWARE**

**1.1 SUMMARY**

- A. Utilize a web based construction project management collaboration software such as Procore ([www.procore.com](http://www.procore.com)) to submit, track, distribute and collaborate on project documentation and action items.
- B. The intent of utilizing a web based construction management application is to reduce cost and schedule risk, improve quality and safety, and maintain a healthy team dynamic by improving information flow, reducing non-productive activities, reducing rework and decreasing turnaround times.

**2.1 SOFTWARE CAPABILITIES (including but not limited to)**

- A. Daily Log
  - 1. Provide daily log entry from web and mobile with automatic capture of daily weather conditions.
  - 2. Provide ability to attach photographs to entries directly from mobile.
  - 3. Provide reporting capabilities to easily report on man-hours and activities for a certain time frame and contractor.
- B. Dashboards
  - 1. Provide a dashboard that shows the status of all currently assigned items with drill down capability to see the subject, assignee and due date of each item.
- C. Deficiency Tracking
  - 1. Provide a means for recording, assigning and confirming completion of any deficiency or observation noted during the course of construction. Must be accessible from web and mobile.
- D. Directory
  - 1. Provide a directory of all team member's contact information that is accessible from web and mobile.
- E. Documents
  - 1. Provide a storage location for miscellaneous project documents with the ability to have a folder hierarchy and privacy settings on folders.
  - 2. There should not be a storage limit.
  - 3. Provide download tracking.
  - 4. Provide the ability to revision and check out files, with access to all previous revisions.
- F. Drawings
  - 1. Provide access to a system maintained current set of drawings on web and mobile, with access to all previous revisions as well.
  - 2. Provide automatic hyperlinking capability for detail callouts.
  - 3. Provide drawing markup capabilities on web and mobile.
  - 4. Provide ability to link RFIs, Submittals, Punchlist Items, Photos and Project Documents to the drawings.
  - 5. Drawing Markups should be carried forward when new revisions are uploaded.
  - 6. Markups and linked documentation should be able to be public or private.
- G. Inspections
  - 1. Provide ability to create inspections from web and mobile.
  - 2. Provide ability to create a deficiency item from an inspection that can be assigned and tracked to completion.
- H. Meetings
  - 1. Provide ability to create, edit and view meeting minutes from web and mobile.
  - 2. Provide ability to create action items with assignees and due dates from a meeting item.
- I. Mobile Accessibility

1. Provide native mobile applications for iOS and Android phones at a minimum that provide access to relevant project documentation, including as-built versions of Drawings and Specifications, even when there is no internet access.
- J. Photos
1. Provide ability to upload and view photos from web and mobile.
  2. Provide ability to markup photos from mobile to clarify anything important in the photo.
  3. Provide ability to link photos to specific locations on drawings.
- K. Punchlist
1. Provide ability to create punch list items from web and mobile and link them to specific locations on the drawings.
  2. Provide ability to distribute punch list items to all contractors, for contractors to mark them as resolved with photographic proof of resolution via mobile, and for the items to be marked as complete via mobile or web.
- L. Requests for Information (RFIs)
1. Provide ability to create RFIs with assignees, due dates and attachments.
  2. Provide ability for assignees to respond to RFIs both via the software and by responding to the system generated email.
  3. Provide an auto-generated log of all RFIs.
- M. Schedule
1. Provide ability to display schedules from typical scheduling software such as Microsoft Project, Primavera P3, Primavera P6 or Asta Powerproject.
- N. Specifications
1. Provide ability to upload project specifications and manage them at the individual specification level.
  2. Provide ability to view and search specifications on web and mobile.
  3. Provide ability to upload revisions to individual specifications and maintain all revision history.
  4. Provide an auto-generated current specification log that provides access to the current version of each specification.
  5. Provide ability to link specifications to submittals and view the specification from the submittal.
- O. Submittals
1. Provide ability to upload a submittal register of all expected submittals.
  2. Provide ability to create multi-step approval workflows for submittals, with reminder notifications for the current assignee.
  3. Provide the ability to upload any file type without size restrictions.
  4. Provide an auto-generated submittal log.

### **3.1 TECHNOLOGY**

- A. Fully web based with mobile apps for Windows, iOS and Android phones.
- B. Accessible without logging in through a virtual private network (VPN).
- C. Works on the current version of Internet Explorer, Google Chrome, Mozilla firefox and Apple Safari browsers.
- D. Can generate emails automatically, and all attachments are included in the emails via download links to avoid emails not being delivered due to size.
- E. PDF output of forms such as RFIs, Submittals, Meetings, Change Orders, etc. should be available and customizable.

### **4.1 TRAINING AND SUPPORT**

- A. The software selected must provide support to all parties via email, phone and live chat at no additional charge.
- B. The software selected must provide training in the form of self-paced learning videos as well as interactive webinars.

- C. The contractor shall hold a kickoff meeting with the Owner and applicable consultants at the beginning of the project to discuss how the software will be used, routing & naming protocols, etc.

## **5.1 PROCEDURES**

- A. RFIs and Submittals
  - 1. The Contractor will be responsible for submitting all RFIs and Submittals through the software and assigning them to the appropriate parties.
  - 2. Architects / Engineers / Consultants etc. are responsible for posting all responses to these items via the software, including all relevant attachments.
  - 3. The Contractor will distribute responses to all affected subcontractors and confirm agreement with the response by closing the item.
- B. Construction Documentation
  - 1. The Contractor will manage Drawings, Specifications and Documents in the software to ensure that the current version of all applicable construction documentation is available to the entire team via web and mobile.
  - 2. The Contractor will ensure that all RFIs which modify the current drawings are posted to the drawings and available via web and mobile within 24 hours of the RFI being responded to.
- C. Contractor will record and distribute meeting minutes and action items via the software.
- D. Contractor will take daily site photos and make them publicly available.
- E. Punchlist
  - 1. All punch list items will be managed through the software.
  - 2. Punchlist items will be created by the Contractor while walking with the Owner and applicable consultants.
  - 3. It will be at the Owner's discretion whether or not Punchlist Items can be closed while a representative from the Owner or applicable consultant is not present.
- F. General
  - 1. It is intended that the contractor will utilize the software for at least all functions identified in "Section B – Software Capabilities."

## **6.1 PRICING**

- A. The Contractor's proposal shall be inclusive of all software or device costs.
- B. The software must allow for unlimited users to ensure that all parties have access to the system.

**END OF SECTION 01 3000**

**Submittal Review**

- |   |  |
|---|--|
| <input type="checkbox"/> Approved                                   | <input type="checkbox"/> Approved as noted |
| <input type="checkbox"/> Revise & Resubmit                          | <input type="checkbox"/> Rejected          |
| <input type="checkbox"/> No review completed                        | <input type="checkbox"/> Reviewed          |
| <input type="checkbox"/> Item submitted, not required<br>for review | <input type="checkbox"/> Other             |

Contractor submittals, such as shop drawings, product data, samples and other data are reviewed only for the limited purpose of checking for conformance with the design concept and the information expressed in the contract documents. This review shall not include review of the accuracy or completeness or details, such as quantities, dimensions, weights or gauges, fabrication processes, construction means or methods, coordination of the work with the other trades or construction safety precautions, all of which are the sole responsibility of the Contractor. This review shall be conducted with reasonable promptness while allowing sufficient time for adequate review. Review of specific items shall not indicate review of the entire assembly of which the item is a component. The Architect shall not be responsible for any deviations from the contract documents not brought to the attention of the Architect in writing by the Contractor. Any deviation from the contract documents shall be clearly indicated to the Architect. The Architect assumes no responsibility for any deviation which is not clearly marked. Reviews of partial submissions for which submissions of correlated items have not been received are not accepted.

***TC Architects, Inc.***

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

**SECTION 01 3216  
CONSTRUCTION PROGRESS SCHEDULE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Construction progress schedule, bar chart type.

**1.2 RELATED SECTIONS**

- A. Section 01 3000 - Administrative Requirements

**1.3 SUBMITTALS**

- A. Within five (5) days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within five (5) days.
- C. Within ten (10) days after review of preliminary schedule, submit draft of proposed complete schedule for review.
  - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment or as required.

**1.4 SCHEDULE FORMAT**

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION**

**3.1 CONTENT**

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
- D. Provide sub-schedules to define critical portions of the entire schedule.
- E. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- F. Provide legend for symbols and abbreviations used.

**3.2 BAR CHARTS**

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

**3.3 REVIEW AND EVALUATION OF SCHEDULE**

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

**3.4 UPDATING SCHEDULE**

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.

- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect including the effects of changes on schedules of separate contractors.

**3.5 DISTRIBUTION OF SCHEDULE**

- A. Distribute electronic copies of updated schedules to Architect, Owner and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

**END OF SECTION 01 3216**

**SECTION 01 3300  
SUBMITTAL PROCEDURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

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

**1.3 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."

**1.4 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: 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: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule 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.

**1.5 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. Paper Submittals:
1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
  2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 or contractor standard transmittal form.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with specification and submittal number.

## **1.6 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.
- 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.
- 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.

## 1.7 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. Do not submit products /data that do not apply to this project.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data 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 kind, color, pattern, and texture for a check of these characteristics with other materials.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
  4. 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.
  5. 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. Emailed color charts will NOT be accepted.
    - 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.
  6. 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.
      - 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. 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.
- E. 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.
- F. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

3. **Manufacturer Certificates:** Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  4. **Material Certificates:** Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
  5. **Product Certificates:** Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
  6. **Welding Certificates:** Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- G. **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 primers and substrate preparation needed for adhesion.
  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.

## 1.8 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, signed and sealed by the responsible design professional licensed in the state of Ohio, 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.

**1.9 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. 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.

**1.10 ARCHITECT'S REVIEW**

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it.
  - 1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements.
- 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 return without review 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 01 3300**

**SECTION 01 4000  
QUALITY REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 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.
  - 4. Specific test and inspection requirements are not specified in this Section.

**1.3 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: 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 trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. 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.
- E. 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.
- F. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- H. 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.
- I. 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.

#### **1.4 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.

#### **1.5 CONFLICTING REQUIREMENTS**

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction 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.

#### **1.6 ACTION SUBMITTALS**

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### **1.7 INFORMATIONAL SUBMITTALS**

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. 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.
- E. 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.

- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. 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.

## **1.8 REPORTS AND DOCUMENTS**

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.
  - 2. Project title and number.
  - 3. Name, address, telephone number, and email address of testing agency.
  - 4. Dates and locations of samples and tests or inspections.
  - 5. Names of individuals making tests and inspections.
  - 6. Description of the Work and test and inspection method.
  - 7. Identification of product and Specification Section.
  - 8. Complete test or inspection data.
  - 9. Test and inspection results and an interpretation of test results.
  - 10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  - 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  - 12. Name and signature of laboratory inspector.
  - 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
  - 1. 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 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 whether conditions, products, and installation will affect warranty.
  - 5. Other required items indicated in individual Specification Sections.

## **1.9 QUALITY ASSURANCE**

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from

manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens and test assemblies, do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

#### **1.10 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, as authorized by Change Orders.
  3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. 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/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Associated Contractor 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 as the Work progresses.
1. 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.

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

### **PART 3 - EXECUTION**

#### **3.1 TEST AND INSPECTION LOG**

- J. 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.
- K. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

#### **3.2 REPAIR AND PROTECTION**

- L. 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 01 7000 "Execution and Closeout Requirements."
- M. Protect construction exposed by or for quality-control service activities.
- N. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

**END OF SECTION 01 4000**

**SECTION 01 4126  
PERMIT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The Owner has obtained and paid for the building permit. Sub-Contractors are responsible for obtaining and paying for permits, licenses, and other local requirements for constructing the Project.

**1.2 SUBMITTALS**

- A. For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION 01 4126**

**SECTION 01 4200  
REFERENCE STANDARDS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative requirements for references. Refer to Divisions 02 through 33 for specific references.

**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 the date of the Contract Documents.
- C. Copies of Standards: Each entity engaged in construction on the Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
  - 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.
- D. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where abbreviations and acronyms are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-producing organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research's "Encyclopedia of Associations" or Columbia Books' "National Trade & Professional Associations of the U.S.," which are available in most libraries.

**1.3 SUBMITTALS**

- A. Permits, Licenses, and Certificates: For the Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION 01 4200**

**SECTION 01 4216  
DEFINITIONS**

**PART 1 - GENERAL**

**1.1 GENERAL DEFINITIONS**

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the user locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the Architect, requested by the Architect, and similar phrases.
- D. "Approved": The term "approved," when used in conjunction with the Architect's action on the Contractor's submittals, applications, and requests, is limited to the Architect's duties and responsibilities as stated in the Conditions of the Contract. Refer to Section 01 3300 - "Submittal Procedures" for additional terms and phrases regarding review/approval/rejection as they relate to submittal procedures.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means to supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
  - 1. The term "experienced," when used with the term "installer," means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.
  - 2. Trades: Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.
  - 3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.
    - a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Work. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.
- J. "Project site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction with others performing other work as part of the Project. The extent of the Project site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

## **1.2 SPECIFICATION FORMAT AND CONTENT EXPLANATION**

- A. Specification Format: These Specifications are organized into Divisions and Sections based on the 50-division format and CSI/CSC's "Master Format" numbering system.
- B. Specification Content: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
  - 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Section Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION 01 4216**

**SECTION 01 5000  
TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Field office.

**1.2 TEMPORARY UTILITIES**

- A. Provide the following:
  - 1. Electrical power and metering.
  - 2. Water supply.
  - 3. Fuel.

**1.3 TELECOMMUNICATIONS SERVICES**

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
  - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
  - 2. Internet Connections: Minimum of one; DSL modem or faster.
  - 3. Email: Account/address reserved for project use.

**1.4 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

**1.5 BARRIERS**

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

**1.6 FENCING**

- A. Construction: Contractor's option as required to secure their work areas. The contractor is responsible to protect all in progress work and materials and equipment as no additional cost or risk to the owner.
- B. If needed or if specified in other sections, provide 6-foot-high fence around construction site; equip with vehicular and pedestrian gates with locks.

**1.7 EXTERIOR ENCLOSURES**

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections,

and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

#### **1.9 SECURITY**

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

#### **1.10 VEHICULAR ACCESS AND PARKING**

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel.

#### **1.11 WASTE REMOVAL**

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### **1.12 PROJECT SIGNS**

- A. One painted sign, 48 sq ft area, bottom 6 feet above ground.
- B. Content:
  - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
  - 2. Names and titles of authorities.
  - 3. Names and titles of Architect and Consultants.
  - 4. Name of General Contractor.

#### **1.13 FIELD OFFICES**

- A. Site Office: Provide a climate-controlled field office of sufficient size and furnishings for convening project meetings for up to 16 persons at a time and for general project administration and on-site record-keeping.

#### **1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 5000**



**SECTION 01 5713  
TEMPORARY EROSION AND SEDIMENT CONTROL**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.

**1.2 REFERENCE STANDARDS**

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP).
- B. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- C. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
- D. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- E. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
  - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
  - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- F. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
  - 1. Control movement of sediment and soil from temporary stockpiles of soil.
  - 2. Prevent development of ruts due to equipment and vehicular traffic.
  - 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- G. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
  - 1. Prevent windblown soil from leaving the project site.
  - 2. Prevent tracking of mud onto public roads outside site.
  - 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
  - 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, wetlands, open drainage ways, storm sewers, and sanitary sewers.
  - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
  - 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

- I. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, wetlands, open drainage ways, storm sewers, and sanitary sewers.
  - 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- J. Open Water: Prevent standing water that could become stagnant.
- K. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

#### **1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Erosion and Sedimentation Control Plan:
  - 1. Include:
    - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
    - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
    - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
    - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
    - e. Other information required by law.
    - f. Format required by law is acceptable, provided any additional information specified is also included.
  - 2. Obtain the approval of the Plan by authorities having jurisdiction.
  - 3. Obtain the approval of the Plan by Owner.
- C. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Refer to C-Series Civil Drawings for specific materials required.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

#### **3.2 PREPARATION**

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

#### **3.3 INSTALLATION**

- A. Comply with requirements indicated on C-Series Civil Drawings.

#### **3.4 MAINTENANCE**

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Clean out temporary sediment control structures weekly and relocate soil on site.
- D. Place sediment in appropriate locations on site; do not remove from site.

#### **3.5 CLEAN UP**

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.

- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

**END OF SECTION 01 5713**

**SECTION 01 5721  
INDOOR AIR QUALITY CONTROLS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Construction procedures to promote adequate indoor air quality after construction.

**1.2 PROJECT GOALS**

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
  - 1. Cleaning of ductwork is not contemplated under this Contract.
  - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
  - 1. Furnish products meeting the specifications.
  - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

**1.3 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.4 REFERENCE STANDARDS**

- A. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; 2012.

**1.5 DEFINITIONS**

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

**PART 3 - EXECUTION**

**2.1 CONSTRUCTION PROCEDURES**

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
  - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
  - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
  - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. Do not store construction materials or waste in mechanical or electrical rooms.
- D. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
  - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
  - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
  - 3. Clean tops of doors and frames.
  - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
  - 5. Clean return plenums of air handling units.
  - 6. Remove intake filters last, after cleaning is complete.
- E. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

- F. Use other relevant recommendations of SMACNA IAQ Guideline for Occupied Buildings Under Construction for avoiding unnecessary contamination due to construction procedures.

**END OF SECTION 01 5721**

**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART1 - GENERAL**

**1.1 SUMMARY**

- A. This Section contains product requirements that apply to all sections of the Specifications.
- B. Refer to the General Conditions for contractual requirements related to products.

**1.2 DEFINITIONS**

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.
  - 1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
  - 3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.
  - 4. "Systems" are sets of complementary materials or products arranged or combined by a manufacturing concern so as to form a unity or whole for fulfilling a specific building (or site) function.
  - 5. "Damage" shall mean a substandard or impaired condition of a product, including breakage, surface blemishes, abrasion, caused by weather exposure, accident, abuse, aging, mis-handling, storage, shipping, or other causes.
  - 6. A "Substitution" is a product not specified and which substantially deviates from the specified requirements.

**1.3 SUBMITTALS**

- A. Product Schedule: Prepare in tabular format a schedule of the specified products to be supplied for the Project (Do not propose substitutions in the Product Schedule). Organize the schedule according to the numbers and titles of each Section. Coordinate the Schedule of Products with the Submittal Schedule. Submit to the Architect not less than 30 days following the Notice to Proceed. Schedule content shall include, as a minimum, the following information:
  - 1. Name of Manufacturer.
  - 2. Product designation, such as brand and model number.
  - 3. Applicable reference standards.
- B. Upon completion of the Project, submit a final Product Schedule for record. Include in the Operation and maintenance manuals. Refer to Section 01 7000 – Execution and Closeout Requirements.

**1.4 BASIC PRODUCT REQUIREMENTS**

- A. Furnish all products new and unused, and in manufacturer's standard unit dimensions, unless specifically identified otherwise in the Contract Documents. Scraps, remnants, salvage, or otherwise objectionable materials will be rejected by the Architect.
- B. Ensure that each type of product is produced by a single manufacturer and obtained through distribution sources authorized by the manufacturer of each product required, unless otherwise approved by the Architect.
- C. All products described in the Contract Documents shall be furnished complete, with all necessary fasteners, accessories, installation devices, and appurtenances required for a complete installation.
- D. All auxiliary components required for proper installation and performance of all products shall be produced and/or approved for the proposed application by the manufacturer of the primary product components.

- E. The Contractor shall verify that products requiring electrical service are compatible with the electrical service available at the Project.

### **1.5 PRODUCT OPTIONS**

- A. The Contractor shall select products which comply with the Contract Documents and which are compatible with each other, with existing work, and with products provided by others.
- B. Manufacturer product references, model numbers, and other proprietary designations used in subsequent sections of the Specifications shall be regarded as minimum standards by which equivalent products by other listed manufacturers should be evaluated and selected. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance. Products of other listed manufacturers shall meet or exceed the design requirements represented by specified proprietary designations.
- C. When products of other listed manufacturers are specified by product reference, model number, or other proprietary designation, the Contractor may choose from among those products listed.
- D. Do not make unauthorized substitutions for products or manufacturers listed. Refer to General Conditions of the Contract for substitution procedures.

### **1.6 PRODUCT SUBSTITUTION PROCEDURES**

- A. The following are administrative procedures for substitutions proposed following Award of Contract.
  - 1. Procedures for proposal of substitutions during the bidding period are specified in "Pricing Instructions."
- B. Do not submit substitution proposals during the period between the Pricing Due Date and Contract Award unless requested by the Architect.
- C. Substitutions following Award of Contract will not be considered except under the following circumstances:
  - 1. Through no fault of the Contractor, the specified products become unavailable as a result of changes in manufacturing, product recalls, supply chain disruptions, changes in laws and regulations, or similar conditions.
  - 2. The Architect and Owner agree to consider Value Engineering proposals.
  - 3. A change of design requirements by the Architect.
- D. The Contractor shall not make substitutions for specified products without submitting a formal request for substitution followed by written approval from the Architect. Unauthorized substitutions will be rejected by the Architect, and the Contractor shall assume all costs for correction or replacement with specified products, whether or not the specifications state that substitutions will not be considered.
- E. Specification requirements indicating that a substitution will not be considered include:
  - 1. "Provide one of the following products:"
  - 2. "Provide Products produced by one of the manufacturers listed."
  - 3. "No Substitutions"
- F. The Contractor shall not assume that the absence of one of the above phrases constitutes permission to make substitutions.
- G. In making requests for substitution, the Contractor shall:
  - 1. Identify the specified product for which the substitution is being proposed.
  - 2. Identify the proposed substitution by manufacturer, model number, series, and other proprietary terms of identification.
  - 3. Provide sufficient information for the Architect to evaluate the proposed substitution, including, as applicable:
    - a. product data
    - b. manufacturer's literature
    - c. test reports
    - d. independent research evaluations

- e. details of fabrication and installation
  - f. maintenance instructions, availability of maintenance parts, and current price list for those parts.
  - g. Name, address, and telephone number of the manufacturer's local representative.
  - h. warranty information
  - i. list of prior installations in the vicinity of the project, including locations, dates of installations, and names of building owners.
  - j. Manufacturer's written endorsement of the installer of the proposed product.
- 4. Furnish a written statement of the net change in the Contract Sum if the substitution is accepted.
  - 5. Furnish a written justification for the substitution in lieu of the specified product.
- H. Allow at least ten (10) business days for the Architect's review and response to substitution requests. The Architect will review substitution proposals and respond to the Contractor in writing. The Architect's decision regarding substitution proposals shall be considered final.
  - I. The Architect may reject without consideration the following:
    - 1. incomplete requests for substitution.
    - 2. substitution requests made when a specification section indicates that no substitutions will be considered for a product.

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

- A. Scheduling: Schedule deliveries to the Site (or other approved location) at times consistent with the progress of the Work to ensure that products do not undergo exposure to unsuitable conditions.
- B. Provide an appropriate level of labor forces and equipment at the site for the proper unloading and handling of products.
- C. Packaging and Identification: Deliver products in original packaging or bundles and labeled so as to be readily identifiable and so that assessment of their condition, quantity, and other qualitative characteristics can be readily performed. Obtain receipts for bulk product deliveries clearly stating the type, grade, quantity and other specified characteristics.
- D. Inventory and Inspection: Inventory products upon receipt to ensure that adequate quantities are delivered at proper intervals so as to maintain the progress of the work. Inspect products to evaluate and document their condition.
- E. Rejection and Re-ordering: Reject defective, broken, deteriorated or otherwise objectionable products and arrange for their immediate segregation and removal from the Project Site. Arrange for delivery of satisfactory products to replace those that have been rejected.
- F. Storage Conditions: Review manufacturer's literature and referenced standards to verify the optimum conditions required for proper and secure storage of each type of product to prevent deterioration, theft, or loss. Maintain such conditions and monitor them throughout the progress of the work. When existing conditions do not comply with referenced standards and manufacturer recommendations, provide and maintain all temporary protections, temporary utility services, and temporary support facilities required to maintain optimum conditions throughout the construction period.
  - 1. Do not store products in a manner that will impede the work of other Contracts or damage structures or excavations.
  - 2. If storage facilities are not available at the Site, provide bonded off-site storage facilities acceptable to the Owner.
- G. Handling: Handle products at all times during the progress of the work in accordance with the referenced standards and manufacturer's printed instructions.

### **1.8 EXTRA PRODUCTS**

- A. Furnish extra products (a.k.a. attic stock or maintenance stock) in the quantities specified, or, when not specified, in the standard quantities customarily furnished by the manufacturer.
- B. Extra products shall be selected from the same runs as the products specified for the work described and shall be delivered to the site when the products to be incorporated into the work



are delivered. Delivery, storage, and handling requirements specified herein apply to extra products.

- C. Furnish extra products in manufacturer's standard whole units, unless otherwise indicated. Scraps, remnants, salvage, or otherwise substandard items presented as extra products will be rejected by the Architect as non-complying.
- D. Furnish extra products in sealed containers or cartons, with manufacturer's name and product description clearly indicated on the packaging.
- E. Contractor shall compensate the Owner for extra products used by the Contractor for performing the work of the Contract or for performing corrective work during the specified correction period or warranty period.
- F. Retain signed receipts for each quantity of extra product delivered to the Owner's designated representative and submit them as a condition of Contract Closeout.

### **1.9 OWNER-FURNISHED PRODUCTS**

- A. Contractor responsibilities:
  - 1. Review of product data, shop drawings, and other submittals provided by the owner.
  - 2. Incorporating owner-furnished products into the construction schedule, maintaining the schedule, and keeping the owner with schedule updates.
  - 3. Coordination with the owner for deliveries to designated locations on a timely basis.
  - 4. Scheduling pre-application conferences with all concerned parties to enhance coordination efforts.
  - 5. Scheduling the proper sequence of installation.
  - 6. Receiving, unloading, handling, and protection of owner-furnished products at the site.
  - 7. Insuring owner-furnished products following receipt.
  - 8. Preparation of owner-furnished products prior to installation.
  - 9. Substrate preparation, blocking, and other necessary construction procedures to facilitate installation of the product.
  - 10. Installation or application.
  - 11. Cleaning and protection of owner-furnished products until final acceptance.

### **1.10 WARRANTIES**

- A. The following requirements are applicable to warranties specified in individual Sections.
- B. Warranties shall not deprive the Owner of other rights provided by law or the Conditions of the Contract.
- C. Date of warranty period commencement shall be the Date of Substantial Completion of the Project, unless the Owner agrees to allow a different date of warranty commencement.
- D. Manufacturer Warranties: Unless more stringent warranty terms are specified within a Section, provide the manufacturer's standard product warranty for each product, running for the manufacturer's standard time period and according to the manufacturer's standard terms.
  - 1. The Contractor shall furnish executed copies of standard manufacturer warranties upon completion of the Project, whether or not the standard warranties are specified in the individual Sections.
- E. Special Project Warranties: When specified, provide special project warranties according to the terms and conditions specified in individual Sections. Submit notarized copies identifying the following:
- F. Manufacturer's name, address, and telephone number.
  - 1. Project title and address.
- G. Owner's name and address.
- H. Contractor's name and address.
  - 1. The specific terms and conditions of the warranty showing compliance with the terms specified in individual Sections.
  - 2. Date of Substantial Completion of the Project.
  - 3. Date of expiration of the warranty.
  - 4. Notarized signature of the manufacturer's authorized agent.

- I. The manufacturer shall notify the Owner and the Contractor in writing not less than 365 days prior to the expiration date of the warranty.
- J. Warranty Requirements:
  - 1. Corrections made under the terms of warranties shall include repair or replacement (as adjudged by the Owner) of interfacing work affected by the product defect.
  - 2. Corrected work shall be fully warranted to the extent of the original work.
  - 3. Perform warranty work in accordance with the Contract Documents applicable to the Work.
  - 4. Warranties that fail to account for the provisions in the Contract Documents will be rejected and re-submittal will be required.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION 01 6000**

**SECTION 01 6116  
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. VOC restrictions for product categories listed below under "DEFINITIONS."
- B. All products of each category that are installed in the project must comply; Owner's project goals do not allow for partial compliance.

**1.2 DEFINITIONS**

- A. VOC-Restricted Products: All products of each of the following categories when installed or applied on-site in the building interior:
  - 1. Adhesives, sealants, and sealer coatings.
  - 2. Carpet tile.
  - 3. Resilient floor coverings.
  - 4. Paints and coatings.
  - 5. Insulation.
  - 6. Gypsum board.
  - 7. Cabinet work.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

**1.3 REFERENCE STANDARDS**

- A. CAL (CHPS LEM) - Low-Emitting Materials Product List; California Collaborative for High Performance Schools (CHPS); current edition at [www.chps.net/](http://www.chps.net/).
- B. CAL (VOC) - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (including Addendum 2004-01); State of California Department of Health Services; current edition
- C. CRI (GLP) - Green Label Plus Carpet Testing Program - Approved Products; Carpet and Rug Institute; Current Edition.
- D. GEI (SCH) - GREENGUARD "Children and Schools" Certified Products; GREENGUARD Environmental Institute; current listings at [www.greenguard.org](http://www.greenguard.org).
- E. GreenSeal GS-36 - Commercial Adhesives; Green Seal, Inc.; current edition.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- G. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at [www.scs-certified.com](http://www.scs-certified.com).

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Evidence of Compliance: Submit for each different product in each applicable category.
- C. Product Data: For each VOC-restricted product used in the project, submit product data showing compliance, except when another type of evidence of compliance is required.
- D. Installer Certifications for Accessory Materials: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of his products, or 2) that such products used comply with these requirements.

**1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. All VOC-Restricted Products: Provide products having VOC content of types and volume not greater than those specified in State of California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions From Various Sources Using Small-Scale Environmental Chambers.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GREENGUARD Children & Schools certification; [www.greenguard.org](http://www.greenguard.org).
    - b. Current Carpet and Rug Institute Green Label Plus certification; [www.carpet-rug.org](http://www.carpet-rug.org).
    - c. Current SCS Floorscore certification; [www.scs-certified.com](http://www.scs-certified.com).
    - d. Current SCS Indoor Advantage Gold certification; [www.scs-certified.com](http://www.scs-certified.com).
    - e. Product listing in the CHPS Low-Emitting Materials Product List at [www.chps.net/manual/lem\\_table.htm](http://www.chps.net/manual/lem_table.htm).
    - f. Current certification by any other agencies acceptable to CHPS.
    - g. Report of laboratory testing performed in accordance with CHPS requirements for getting a product listed in the Low-Emitting Materials Product List; report must include laboratory's statement that the product meets the specified criteria.
  - 2. Product data submittals showing VOC content are NOT acceptable forms of evidence.
- B. Adhesives and Joint Sealants: Provide only products having volatile organic compound (VOC) content not greater than required by South Coast Air Quality Management District Rule No.1168.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- C. Aerosol Adhesives: Provide only products having volatile organic compound (VOC) content not greater than required by GreenSeal GS-36.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current GreenSeal Certification.
    - b. Report of laboratory testing performed in accordance with GreenSeal GS-36 requirements.
    - c. Published product data showing compliance with requirements.
- D. Paints and Coatings:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
  - 3. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
    - b. Published product data showing compliance with requirements.
    - c. Certification by manufacturer that product complies with requirements.
- E. Carpet and Adhesive: Provide products having VOC content not greater than that required for CRI Green Label Plus certification.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Current Green Label Plus Certification.
    - b. Report of laboratory testing performed in accordance with requirements.
- F. Carpet Tile and Adhesive: Provide products having VOC content as specified in Section 09 6813.

**PART 3 - EXECUTION**

**3.1 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. All additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION 01 6116**

**SECTION 01 7000  
EXECUTION AND CLOSEOUT REQUIREMENTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Surveying for laying out the work.
- D. Cleaning and protection.
- E. Starting of systems and equipment.
- F. Demonstration and instruction of Owner personnel.
- G. Closeout procedures, except payment procedures.
- H. General requirements for maintenance service.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittals procedures.
- B. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- C. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties and bonds.

**1.3 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2009.

**1.4 PREPARATION**

- A. Install representative construction, such as mock-ups and field samples, as specified in subsequent sections. Do not proceed with work execution until representative construction has been reviewed and approved by the Architect and Owner in accordance with Section 01 400 - Quality Requirements.
- B. Prepare materials for installation in accordance with referenced industry standards, manufacturer's instructions, and accepted trade practices. In exposed or finish work, mix or arrange materials for uniform blending and optimum arrangement according to the Architect's instructions.
- C. Lay out work in advance to ensure accurate spacing of surface patterns with uniform joint thicknesses and for accurate location of openings, joints, returns, and offsets.
- D. Surface Preparation
  - 1. Furnish, install, maintain, and remove as required all necessary temporary protections to safeguard persons and property in the vicinity of the surface preparation area prior to commencement of surface preparation procedures, including but not limited to protection of HVAC system and existing adjacent construction.
  - 2. Prepare surfaces to receive work in accordance with manufacturer's instructions, referenced standards and accepted trade practices.

**1.5 EXECUTION, GENERAL**

- A. The work shall be performed by skilled and, where applicable, by licensed installers. Where indicated in the Contract Documents, installers shall be approved by the manufacturer for installing the materials in the manner indicated.
- B. Install work in accordance with recognized trade practices, unless more stringent installation requirements are described in the Contract Documents or in the approved manufacturer's published installation instructions. For materials or systems that are specified to receive warranties, Work shall also comply with the requirements of the manufacturer.
- C. Construct work to the full elevations, widths, and thicknesses shown.
- D. Build chases and recesses to accommodate items specified in this Section and in other Sections of the Specifications.

- E. Leave openings for equipment to be installed before completing work. After installing equipment, complete work to match the construction immediately adjacent to the opening.
- F. As work progresses, build in items furnished under other sections

## 1.6 FINISHING

- A. Except where specifically noted to remain unfinished, prepare, prime, and finish exposed elements of installed materials and products, whether or not indicated on the Finish Schedule, and in a manner acceptable to the Owner and Architect.
  - 1. Finish surfaces of installed work that are not pre-finished by the manufacturer or fabricator, including but not limited to metal, wood, cementitious elements, and paper-covered elements.
  - 2. Finishing includes but is not limited to, as applicable, insulating, filling, and sealing joints between frames and substrates, surface preparation, priming and painting or staining and sealing in accordance with the manufacturer's recommendations and the Owner's finish scheme.
  - 3. Final colors and sheen will be selected by the Architect.
  - 4. Do not conceal or paint over labels, warnings, tags, certificates, or other information required by authorities having jurisdiction.
  - 5. Refer to Division 09 Sections and the manufacturer's instructions for additional finishing requirements.
- B. Additional Building Envelope Requirements: Execute the Work in a manner that optimizes the moisture resistance, thermal performance, and acoustical performance of the facility. As such:
  - 1. Back-prime and weather-proof components installed as part of building shell, substructure and foundation construction.
    - a. Weatherproofing includes but is not limited to membranes, drainage fill, screening, mastics, flashing, sealants, and coatings as indicated on the Drawings, specified in subsequent Sections, required by authorities having jurisdiction, and recommended by referenced standards and manufacturers.
  - 2. Seal the backs and edges of wood, sheathing, gypsum board, insulation, concrete, and other potentially absorptive materials that will be exposed to the weather and damp or humid conditions.
  - 3. Isolate dissimilar metals from each other to prohibit galvanic action.
  - 4. Isolate metals and other corrosion-sensitive materials from components containing deleterious or otherwise reactive chemicals, including but not limited to pressure-treated wood, solvents, and incompatible sealants.
  - 5. Install permanent water stops in intersecting elements of concrete foundations to prevent the intrusion of water under slabs.
  - 6. Fill voids and annular spaces between dissimilar building components with insulation, gaskets, and joint fillers to assure the moisture resistance, thermal performance, and acoustical performance qualities of the building.
  - 7. Insulate and seal all voids in the building shell whether or not designated in a work scope definition or identified in the Contract Documents, but which is an ordinary procedure according to referenced standards and manufacturer recommendations.
  - 8. Assure positive, uninterrupted drainage of roofs, ledges, parapets, sills, pavement, graded areas, and other facility components that may collect precipitation. Assure that gutters, drainage lines, swales, ditches and other conveying elements direct water to legal collection and discharge points so as to preserve constructed elements from water damage.
    - a. Provide gratings, filters, and similar elements that prevent the intrusion of debris into drainage structures and permit periodic cleanout. Secure gratings and covers in a manner acceptable to the owner so as to prevent theft.
  - 9. Construct walls, eaves, soffits, plenums, attics, parapets and other similar elements to properly drain and ventilate so as to prevent condensation and precipitation from damaging building shell elements and adversely affecting indoor air quality.

- a. Provide vents, louvers, weep systems, and similar elements that are designed to prevent the intrusion of insects, rodents, birds, and similar wildlife into concealed spaces by means of inert polymer screens, wicks, Matrices, and other means.
- 10. Assure that fasteners selected are of the correct type for the applications indicated, are corrosion-resistant, and will not react with the penetrated substrates when installed. Space fasteners appropriately. Provide pre-finished fasteners when required for aesthetic effect.
- 11. Account for thermal movement of installed materials in executing the Work.
  - a. Incorporate washers, gaskets, movement joints, and other appropriate means according to manufacturer instructions and referenced standards.
- 12. Coat primed and unprimed ferrous metals with suitable finish systems approved by the Architect.
  - a. Unless otherwise indicated, do not paint, stain, or otherwise coat stainless steel, chrome, bronze, brass, or other metals that have received a defined mechanical finish and are intended to remain exposed.
- 13. Refer to subsequent Sections and the manufacturer's instructions for additional requirements.

## 1.7 PROJECT CONDITIONS

- A. Prior to installation of products or systems, with Installer present, review the condition of the substrate or area of installation provided and verify that it is acceptable in accordance with the product manufacturer's instructions, referenced standards, and accepted trade practices. Report unfavorable conditions to the Architect. Verify that reinforcement, blocking, nailers, or other attachment provisions required for support of work are properly placed. Do not allow installation to proceed until all unsatisfactory conditions have been corrected. Commencing work in an area will be considered acceptance of the existing conditions by that Installer and the Contractor shall assume all responsibility therefore.
- B. No allowance will be made for conditions that, in the opinion of the Architect, were foreseeable during the bidding period or reasonably inferable from the Contract Documents.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
  - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
  - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- F. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Minimize amount of bare soil exposed at one time.
  - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
  - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
  - 1. Pest Control Service: Weekly treatments.
- I. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.



- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

## **1.8 COORDINATION**

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

### **3.2 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### **3.3 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

### **3.4 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
  - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  - 2. Grid or axis for structures.
  - 3. Building foundation, column locations, ground floor elevations.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.5 GENERAL INSTALLATION REQUIREMENTS**

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.6 PROGRESS CLEANING**

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

### **3.7 PROTECTION OF INSTALLED WORK**

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

### **3.8 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and owner seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.9 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.10 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

### **3.11 FINAL CLEANING**

- A. Execute final cleaning prior to final project assessment.
  - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.12 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
  - 1. Provide copies to Architect and Owner.
    - a. Provide one electronic copy for Architect.
    - b. Provide one electronic copy and one paper hard copy for Owner.
- B. Notify Architect when work is considered ready for Substantial Completion.
- C. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.

- D. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.
- E. Notify Architect when work is considered finally complete.
- F. Complete items of work determined by Architect's final inspection.

**3.13 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION 01 7000**

**SECTION 01 7419  
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition and construction waste.
  - 2. Recycling nonhazardous demolition and construction waste.
  - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 31 1000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

**1.2 DEFINITIONS**

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

**1.3 ACTION SUBMITTALS**

- A. Waste Management Plan: Submit plan within 7 days of date established for the Notice to Proceed.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
  - 1. Material category.
  - 2. Generate points of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste salvaged, both estimated and actual in tons.
  - 5. Quantity of waste recycled, both estimated and actual in tons.
  - 6. Total quantity of waste recovered (salvaged plus recycled) in tons.
  - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

### **1.5 QUALITY ASSURANCE**

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements.

### **1.6 WASTE MANAGEMENT PLAN**

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
  - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
  - 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
  - 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  - 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total nonhazardous solid waste generated by the Work. Facilitate recycling and salvage of materials.

## **PART 3 - EXECUTION**

### **3.1 PLAN IMPLEMENTATION**

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
  - 1. Distribute waste management plan to everyone concerned within three days of submittal return.
  - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
  - 2. Comply with Section 01 5000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### **3.2 SALVAGING DEMOLITION WASTE**

- A. Salvaged Items for Reuse in the Work:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  - 3. Store items in a secure area until installation.
  - 4. Protect items from damage during transport and storage.
  - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
  - 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.

### **3.3 RECYCLING [DEMOLITION] [AND] [CONSTRUCTION] WASTE, GENERAL**

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Owner.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
  - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  - 4. Store components off the ground and protect from the weather.
  - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

### **3.4 RECYCLING DEMOLITION WASTE**

- A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch size.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
  - 1. Pulverize concrete to maximum 4-inch size.

- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
  - 1. Pulverize masonry to maximum 1-1/2-inch size.
  - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- G. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- H. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- I. Conduit: Reduce conduit to straight lengths and store by material and size.

### **3.5 RECYCLING CONSTRUCTION WASTE**

- A. Packaging:
  - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
  - 2. Polystyrene Packaging: Separate and bag materials.
  - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
  - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Wood Materials:
  - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
  - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
- C. Paint: Seal containers and store by type.

### **3.6 DISPOSAL OF WASTE**

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.  
Burning: Burning of waste materials is NOT permitted on Owner's property.

**END OF SECTION 01 7419**



**SECTION 01 7800  
CLOSEOUT SUBMITTALS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

**1.3 SUBMITTALS**

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
  - 1. Submit one copy of preliminary draft or proposed formats and outlines of contents electronically before start of Work. Architect will review draft and return with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Electronic submission will be accepted. Revise content of all document sets as required prior to final submission.
  - 4. Submit revised final documents in final form within 10 days after final inspection.
    - a. Submit one electronic copy to Architect.
    - b. Submit one electronic copy and one paper hard copy to Owner.
- C. Warranties and Bonds:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
  - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION**

**3.1 PROJECT RECORD DOCUMENTS**

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.

- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  1. Field changes of dimension and detail.
  2. Details not on original Contract drawings.

### **3.2 OPERATION AND MAINTENANCE DATA**

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

### **3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES**

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

### **3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS**

- A. For Each Item of Equipment and Each System:
  1. Description of unit or system, and component parts.
  2. Identify function, normal operating characteristics, and limiting conditions.
  3. Include performance curves, with engineering data and tests.
  4. Complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Additional Requirements: As specified in individual product specification sections.

### **3.5 OPERATION AND MAINTENANCE MANUALS**

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 by 11 inch (216 by 280 mm) three D side ring binders with durable plastic covers; 2 inch (50 mm) maximum ring size. When multiple binders are used, correlate data into related consistent groupings.

- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop drawings and product data.

### **3.6 WARRANTIES AND BONDS**

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

**END OF SECTION 01 7800**

**SECTION 01 7900  
DEMONSTRATION AND TRAINING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
  - 1. HVAC systems and equipment.
  - 2. Elevator.
  - 3. Access Control.
  - 4. Security.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.

**1.3 SUBMITTALS**

- A. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
  - 1. Include applicable portion of O&M manuals.
  - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
  - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

**1.4 QUALITY ASSURANCE**

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
  - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
  - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

**PART 2 - PRODUCTS - NOT USED**

**PART 3 - EXECUTION**

**3.1 DEMONSTRATION - GENERAL**

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
  - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
  - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

**3.2 TRAINING - GENERAL**

- A. Conduct training on-site unless otherwise indicated.
- B. Product- and System-Specific Training:

1. Review the applicable O&M manuals.
  2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
  3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
  4. Provide hands-on training on all operational modes possible and preventive maintenance.
  5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
  6. Discuss common troubleshooting problems and solutions.
  7. Discuss any peculiarities of equipment installation or operation.
  8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
  9. Review recommended tools and spare parts inventory suggestions of manufacturers.
  10. Review spare parts and tools required to be furnished by Contractor.
  11. Review spare parts suppliers and sources and procurement procedures.
- C. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

**END OF SECTION 01 7900**

SECTION 018113  
Germantown Crossing  
SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

GENERAL CONDITIONS

- A. The General Conditions, Modifications to General Conditions, Supplementary or Special Conditions and any Instructions to Bidders shall apply to all Divisions of work.
- B. The requirements of State, Local or appropriate codes applicable to the work, whichever is the most stringent is a requirement of all Divisions of work.

WORK OF THIS SECTION

- A. LEED Certification requirements
- B. The intent of this project is to achieve a **Silver- level** LEED certification under the **LEED BD+C Homes and Multifamily Low-rise** rating system.
- C. Contractor shall coordinate work and requirements with Owner Contracted LEED Homes verification team comprising **LEED Provider and Green Rater**. Pertinent to LEED certifications the role of the verification team is to guide the construction team with certification process; review documentation, verify green requirements are met; and to perform third-party testing.

REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
  - 1. ASHRAE 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - 2. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
  - 3. ASHRAE 90.1 - Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
  - 4. ASHRAE 129 - Measuring Air-Change Effectiveness.
- B. ASTM International:
  - 1. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
  - 2. ASTM E903 - Standard Test Method for Solar Absorption, Reflectance, and Transmittance of Materials Using Integrating Spheres.
- C. Bay Area Air Quality Management District: BAAQMD Regulation 8, Rule 51 –
- D. Adhesive and Sealant Products. Carpet and Rug Institute: CRI Green Label Testing Program.
- E. Forest Stewardship Council: FSC Guidelines- Forest Stewardship Council Guidelines.
- F. Green Seal: GS-11 - Product Specific Environmental Requirements.
- G. California Department of Public Health Standard Method V1.1–2010, using CA Section 01350, Appendix B.
- H. Sheet Metal and Air Conditioning Contractors: SMACNA IAQ - IAQ Guidelines for Occupied Buildings under Construction.
- I. South Coast Air Quality Management District: SCAQMD Rule 1168 - Adhesive and Sealant Applications.

- J. U.S. Environmental Protection Agency:
  - 1. EPA 832-R-92-005 - Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.
  - 2. EPA Baseline IAQ - Testing for Indoor Air Quality, Baseline IAQ, and Materials Section 01445
  - 3. EPA 402-K-01-002 – A Step-by-Step Guide on how to Build Radon-Resistant Homes
- K. U.S. Green Building Council:
  - 1. LEED Version 4 - Reference Guide for Homes Design & Construction
- L. ENERGY STAR Qualified Homes
  - 1. Energy Star National Rater Design Review Checklist
  - 2. Energy Star National Rater Field Checklist
  - 3. Energy Star National HVAC Design Report
  - 4. Energy Star National HVAC Commissioning Checklist
  - 5. Energy Star Water Management System Builder Checklist

#### SUBMITTALS

- A. The contractor shall submit the following items directly to the Green Rater.
  - 1. Attendee list of On-site LEED Trades Training meeting moderated by LEED Verification Team (LEED Green Rater and/or Provider-QAD)
  - 2. Energy Star Water Management System Builder Checklist signed and initialed by General Contractor.
- B. Energy Star HVAC System Quality Installation Contractor Checklist signed and initialed by HVAC Contractor credentialed by an EPA-recognized HVAC Quality Installation Training and Oversight Organization (H-QUITO)
  - 1. If tropical wood is used – Provide invoices for FSC certified wood with Chain of Custody Certificate number.
  - 2. Construction Waste Volume or Weight and Diversion Rate (Calculation and Waste Hauling Tickets)
  - 3. Provide documentation of dates and times of pre-occupancy flush schedule to Green Rater.
- C. Signed LEED Accountability Form certifying that all products meet or exceed the specified requirements and the requirements of LEED, as noted with "LEED". Submit this information as part of the product submittals.
- D. The contractor shall submit cut-sheets of products intended to comply with Environmentally Preferable Products (EEP). See LEED checklist for list of products intended to meet this requirement. EPP criteria are as follows:
  - 1. Recycled Content Requirement:
    - a. Minimum 25% post-consumer or 50% post-industrial. OR
    - b. The product contains at least 25% reclaimed material, including salvaged, refurbished, or reused materials.
    - c. Bio-based materials. Bio-based products must meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials must be tested using ASTM Test Method D6866 and be legally harvested, as defined by the exporting and receiving country.
    - d. Concrete that consists of at least 30% fly ash or slag used as a cement substitute and 50% recycled content or reclaimed aggregate OR 90% recycled content or reclaimed aggregate.
  - 2. Low Emissions Requirement– See specific requirements for Low-VOC paints, Adhesives and Sealants at end of this section.
  - 3. Local Production Requirement – Extracted, manufactured, and fabricated (all processes) within a 100-mile crow-fly distance of site.

## QUALITY ASSURANCE

1. Perform work in accordance with the **LEED Version 4 - Reference Guide for Homes Design & Construction** for prerequisites and credits pertinent to this project listed in LEED Checklist included at the end of this section.
  - A. Maintain one copy of LEED for Homes Rating System document on site. Download at <https://www.usgbc.org/resources/leed-v4-homes-and-multifamily-midrise-current-version>
  - B. Perform inspections to assure conformance to Energy Star Qualified Homes Checklists throughout construction of the project. A copy of all pertinent Energy Star Inspection Checklists is enclosed at end of this section.
  - C. Monitor closely any requests for substitution for products that are related to LEED prerequisites and credits. Unless reviewed thoroughly substitutions may jeopardize projects' ability to obtain certification.
  - D. Perform storm water management and erosion control Work in accordance with EPA Best Management Practices or local erosion and sedimentation control standards, whichever is more stringent.
  - E. Perform Work to meet or exceed minimum energy efficiency and performance in accordance with Energy Star requirements and local energy code, whichever is more stringent.
  - F. Perform Work without use of CFC based refrigerants in HVAC building systems.
  - G. Perform ventilation Work in accordance with ASHRAE 62.
  - H. Develop and implement construction indoor air quality management plan including the following:
    1. Comply with minimum requirements of SMACNA IAQ.
    2. Protect stored and installed absorptive materials from moisture damage.
      - a. Store materials on elevated platforms under cover, and in dry location.
      - b. When materials are not stored in enclosed location, cover tops and sides of material with secured waterproof sheeting.
    3. Protect HVAC equipment during construction.
      - a. Shut down return side of HVAC system whenever possible during heavy construction or demolition.
      - b. When HVAC system is operated during heavy construction, furnish disposable temporary filters.
    4. Pre-Occupancy Flush: Flush the entire building with fresh air for a total of 48 hours after all construction is complete. Run continuous fans through the duration of the flush. Replace all HVAC filters upon completion.

## PART 2 – PRODUCTS

### PRODUCT SUBSTITUTION

- A. Monitor closely any requests for substitution for products that are related to LEED prerequisites and credits. Unless reviewed thoroughly substitutions may jeopardize projects' ability to obtain certification.



## PART 3 - EXECUTION

LEED PREREQUISITES AND CREDITS (See enclosed LEED Checklist for more information)

### INTEGRATIVE PROCESS

#### **A. IP Credit 1.3 (option 3) – Trades Training**

1. At the onset of construction organize a LEED trades training moderated by LEED Green Rater and/or Provider-QAD.
2. Following trades to attend - GC Project Manager, GC Site Superintendent, Mechanical-Electrical-Plumbing, Insulation, Framing, Drywall, Air-Infiltration Package.
3. Provide a minimum of 2-week notice to LEED Green Rater prior to training date.

### SUSTAINABLE SITES

#### **A. SS Prerequisite 1 - Construction Activity Pollution Prevention**

1. Stockpile and protect disturbed topsoil from erosion (for reuse).
2. Control the path and velocity of runoff with silt fencing or comparable measures.
3. Protect on-site storm sewer inlets, streams, and lakes with straw bales, silt fencing, silt sacks, rock filters, or comparable measures.
4. Provide swales to divert surface water from hillsides.
5. Use tiers, erosion blankets, compost blankets, filter socks, berms, or comparable measures to stabilize soils in any area with a slope of 15% (6.6:1) or more that is disturbed during construction.
6. Prevent air pollution from dust and particulate matter.
7. Construction sites larger than 1 acre must conform to the erosion and sedimentation requirements of the 2012 U.S. Environmental Protection Agency Construction General Permit or local equivalent, whichever are more stringent.

#### **B. SS Prerequisite 2 - No Invasive Plants**

1. Coordinate with Landscape Contractor to ensure no invasive plant species are introduced into landscape.

#### **C. SS Credit 3 – Non-toxic Pest Control**

1. For below-grade walls, use solid concrete foundation walls, masonry walls with a course of solid block bond beam, or concrete-filled block.
2. Design a minimum 6-inch inspection space between the surface of the planned landscape grade and non-masonry siding.
3. Seal all external cracks, joints, penetrations, edges, and entry points with appropriate caulking. Install rodent and corrosion-proof screens (e.g., copper or stainless-steel mesh) on all openings greater than 1/4 inch, except where code prohibits their installation (e.g., dryer vents).
4. Design discharge points for rain gutters, air-conditioning condensation lines, steam vent lines, or any other moisture source such that discharge is at least 24 inches from the foundation.
5. Multifamily building projects **must** develop an integrated pest management policy that includes guidance for residents on pesticide use, housekeeping, and prompt reporting of pest problems; incorporate the policy in the Homeowner Education Manual.

### WATER EFFICIENCY

#### **A. WE Prerequisite 1 – Water Metering**

1. Multifamily: Install a water meter for each building.

## **B. WE Credit 2 – Indoor Water Use**

Provide product data showing flow rates for following fixtures:

1. Average flow rate of lavatory faucets shall be 1.50 gallons per minute or less. Each lavatory faucet or faucet aerator must be WaterSense labeled.
2. Average flow rate of showers shall be 1.50 gallons per minute or less. Each showerhead fixture and fitting must be WaterSense labeled.

## ENERGY & ATMOSPHERE

### **A. EA Prerequisite 1– Minimize Energy Performance (Single-Family and Multifamily Low-rise)**

1. Meet the requirements of ENERGY STAR for Homes, version 3.
2. Complete the thermal enclosure system rater checklist, the HVAC system quality installation rater and contractor checklists, and the water management system builder checklist. Certified Passive House projects automatically meet the thermal enclosure system rater checklist requirement. Achieve a HERS index rating at or below the HERS index target or meet the requirements of the ENERGY STAR for Homes version 3.
3. At least one of the following appliances must be ENERGY STAR qualified and installed in each dwelling unit: refrigerator; OR dishwasher; OR clothes washer.
4. All duct runs must be fully ducted (i.e., building cavities may not be used as ducts).
5. Minimum envelope leakage – following areas of building envelope and demising walls shall be sealed, caulked, gasketed, or weather-stripped to minimize envelope leakage:
  - a. Joints around windows and doors.
  - b. Joints between walls and foundation; between conditioned spaces and attics, demising walls, crawl spaces or garage.
  - c. Seal joints between sill plate and drywall.
  - d. Seal joints between top plate and drywall.
  - e. All mechanical, plumbing, and electrical penetrations in exterior and demising walls. Mechanical chase shall be sealed at crawl space ceiling.
  - f. Exterior sheathing and house wrap.
  - g. Minimize entry of air from outdoors, attic, garage, and crawl space into exterior wall and interior wall cavities to ensure passing of air infiltration test.
  - h. Batt insulation shall be stapled to face of stud to ensure full contact of insulation with face of drywall. Cut insulation around all mechanical, plumbing, and electrical work.
6. Thermal Bypass Inspection - The Green Rater will conduct a visual Thermal Bypass Inspection to inspect proper installation and continuity of thermal insulation and air-tightness of envelope. This inspection must take place after exterior envelope insulation has been installed, but prior to and installation of any drywall. One inspection per floor shall be conducted. If additional inspections are deemed necessary due construction sequencing, Contractor shall notify the Architect and Green Rater immediately. Contractor shall schedule the inspection with no less than a two-week notice to the Green Rater. Contractor shall provide access to each unit and cooperate with conducting of the test. Additional inspections necessary due to incomplete work shall be back-charged to the Contractor. A sample Thermal Bypass Inspection Checklist is enclosed in section 018113.
7. Final Inspections - Upon substantial completion and prior to occupancy, the Green Rater will conduct a visual Final Inspection to verify green requirements incorporated in the project. The contractor shall notify the Green Rater at least four (4) weeks prior to the anticipated date for such inspection. Contractor shall provide access to each unit and cooperate with conducting of the test. Additional inspections necessary due to incomplete work shall be back-charged to the Contractor.
8. Third-Party Testing -

Third-party Testing is to be scheduled and conducted in conjunction with the final inspection. The contractor shall notify the Green Rater at least four (4) weeks prior to the anticipated date for such inspection. Contractor shall provide access to each unit and cooperate with conducting of the test. The following tests shall be conducted by Green Rater:

- a. Air Infiltration Test (Blower door Test) – Mandatory – Measures air leakage through unit enclosure such as exterior walls, demising walls, ceilings, chases, etc.
- b. Distribution Loss Test (Duct Blaster Test) – Mandatory – Measures leakage through the mechanical distribution system
- c. Exhaust Test - Measures exhaust rate for bathroom fans and kitchen fans.
- d. Flow Test and Balancing – Measure air flow at each supply register and pressure differential between rooms.

**B. EA Prerequisite 2 – Energy Metering**

For Multifamily Buildings

1. Install an electricity meter or submeter for each residential unit and a gas meter for the entire building, or a gas meter or sub-meter for each unit.

**C. EA Prerequisite 3 – Education of the Homeowner, Tenant, or Building Manager**

1. General Contractor to provide to Owner or Owner's Building Management an operations and maintenance manual, binder, or CD that includes all the following items:
  - a. the completed checklist of LEED-related features;
  - b. a copy of each signed accountability form;
  - c. copies of all ENERGY STAR for Home, version 3, checklists;
  - d. product manufacturers' manuals for all installed equipment, fixtures, and appliances;
  - e. general information on efficient use of energy, water, and natural resources;
  - f. operations and maintenance guidance for any installed equipment, including space heating and cooling, mechanical ventilation, humidity control, radon protection, renewable energy, and irrigation, rainwater harvesting, or graywater systems (following 2009 EPA WaterSense Single-Family New Home Specifications, item 5.0, Homeowner Education);
2. LEED Green Rater to assist with following items for inclusion in manuals:
  - a. guidance on occupants' activities and choices, including cleaning materials and methods, water-efficient landscaping, integrated pest management, effects of chemical fertilizers and pesticides, irrigation, lighting selection, and appliance selection;
  - b. information on local green power options; and
  - c. information on sharing utility data with USGBC via a USGBC-approved third party.
3. General Contractor to conduct a minimum one-hour walkthrough of the home with Owner and/or building manager. The walkthrough must feature the following:
  - a. identification of all installed equipment;
  - b. instruction in how to use and operate the equipment; and
  - c. information on its maintenance.

**MATERIALS & RESOURCES**

**A. MR Prerequisite 1 – Certified Tropical Wood**

1. All wood in the building must be non-tropical, reused or reclaimed, or certified by the Forest Stewardship Council, or USGBC-approved equivalent.
2. If tropical wood is used it must be FSC Certified. Provide vendor's chain-of-custody certificate number must be shown on any invoice that includes FSC-certified products.

**B. MR Prerequisite 2 – Durability Management**

1. Meet the requirements of the ENERGY STAR for Homes, version 3, water management system builder checklist attached at end of this section.
2. Install all the applicable indoor moisture control measures:
  - a. Area directly above bathtub, spa, or shower (extending to ceiling), exposed wall or area behind fiberglass enclosure if wallboard is installed - Use non-paper-faced backer board

or paper-faced product or coating over wallboard that meets standard ASTM D 3273 standard

- b. Kitchen, bathroom, laundry room, spa area - Use water-resistant flooring; do not install carpet.
- c. Install water resistant flooring (not carpet) within 3 feet of exterior doors accessible from ground.
- d. Tank water heater in or over living space - Install drain and drain pan, drain pan and automatic water shut-off or flow restrictor, or floor drain with floor sloped to drain.
- e. Clothes washer (or condensing clothes dryer) in or over living space - Install drain and drain pan, drain pan and automatic water shut-off or flow restrictor, floor drain with floor sloped to drain, or braided washer hose.
- f. Conventional clothes dryer - Exhaust directly to outdoors

**C. MR Credit 1 – Durability Management Verification**

1. LEED verification team (Green Rater) to inspect and verify each measure listed in the ENERGY STAR for Homes, version 3, water management system builder checklist.
2. Allow Green Rater access to the premise to inspect items in ENERGY STAR for Homes, version 3, water management system builder checklist.

**D. MR Credit 2 – Environmentally Preferable Products**

1. Option 1 - Local Production - Use products that were extracted, processed, and manufactured locally within 100 miles of site and for the following components (at least 50% of the component). Contractor to provide documentation proving compliance with Environmentally Preferable Product requirements for the following products:
  - a. Aggregate for concrete and foundation
2. Option 2 – Environmentally Preferable Products –Use synthetic gypsum board products that contain at least 95% recycled content and non-synthetic gypsum board products that contain at least 10% post-consumer recycled content. Contractor to provide documentation proving compliance with Environmentally Preferable Product requirements for the following products:
  - a. Drywall, Interior Finish

**E. MR Credit 4 – Material Efficient Framing**

1. Implement any of the following advanced framing techniques for at least 90% of each component.
  - a. Space floor joists greater than 16 inches o.c. or.
  - b. Space roof rafters greater than 16 inches o.c.

**INDOOR ENVIRONMENTAL QUALITY**

**A. EQ Prerequisite 1 – Ventilation**

Multifamily

1. Local Exhaust
  - a. Design and install local exhaust systems in all bathrooms (including half-baths) and the kitchen to meet the requirements of ASHRAE Standard 62.2–2010, Sections 5 and 7 or local equivalent, whichever is more stringent. Provide minimum intermittent local exhaust flow rates of 100 cfm or 5ACH in kitchen, and 50 cfm in bathrooms.
  - b. Exhaust air to the outdoors. Do not route exhaust ducts to terminate in attics or interstitial spaces. Just recirculating range hoods or recirculating over-the-range microwaves do not satisfy the kitchen exhaust requirements.
  - c. Use ENERGY STAR–labeled bathroom exhaust fans in all bathrooms.
  - d. For exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute (188 liters per second), provide makeup air at a rate approximately equal to the exhaust air rate. Makeup air systems must have a means of closure and be automatically controlled to start and operate simultaneously with the exhaust system.
2. Ventilation

- a. Fresh air ventilation to dwelling units shall comply with ventilation requirements of ASHRAE 62.2–2010.
  - b. Do not use systems that rely on transfer air from pressurized hallways or corridors, adjacent dwelling units, attics, etc.
  - c. Project teams using exhaust-only ventilation systems must comply with flow rate required by ASHRAE 62.2–2010. If bathroom exhaust fan is used for exhaust-only fresh-air ventilation, then refer to HVAC drawings for exhaust fan run-time and controls. Coordinate continuous / intermittent fan run-time and controls with HVAC and Electrical contractor. Provide dual-speed bathroom exhaust fan with continuous speed set to 30 cfm in 1-Bedroom units, 45 cfm in 2-Bedroom units, and 45 cfm in 3-Bedroom units.
  - d. Continuous in-unit ventilation fans must be rated for sound at a maximum of 1.0 sone, per ASHRAE 62.2–2010, Section 7.2.1. Remote mounted fans need not meet these sound requirements.
  - e. Locate air inlets that are part of the ventilation design at least 10 feet (3 meters) from known sources of contamination, such as a stack, vent, exhaust hood, or vehicle exhaust. Place the intake such that entering air is not obstructed by snow, plantings, or other material. Forced air inlets must be covered by screens to exclude rodents and insects (mesh not larger than 1/2 inch or 13 millimeters).
3. For all non-unit spaces, meet the minimum requirements of ASHRAE Standard 62.1–2010 or local equivalent, whichever is more stringent, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata). Mechanically ventilated spaces must be designed using the ventilation rate procedure or the applicable local code, whichever is more stringent. Ventilation fans that penetrate rated assemblies may require radiation and fire dampers to meet local building and fire codes.

#### **B. EQ Prerequisite 2 – Combustion Venting**

1. Do not install any unvented combustion appliances (ovens and ranges excluded).
2. Install a carbon monoxide (CO) monitor on each floor, hard-wired with a battery backup. In multifamily buildings, install a CO monitor on each floor of each unit.
3. For all fireplaces and woodstoves inside the building, provide doors that close or a solid glass enclosure. Interior fireplaces and woodstoves that are not closed-combustion or power-vented must pass BPI or RESNET combustion safety testing protocols to ensure that depressurization of the combustion appliance zone is less than 5 Pa.
4. Space- and water-heating equipment that involves combustion must meet one of the following:
  - a. it must be designed and installed with closed combustion (i.e., sealed supply air and exhaust ducting);
  - b. it must be designed and installed with power-vented exhaust; or
  - c. it must be located in a detached utility building or open-air facility.

#### **C. EQ Prerequisite 3 – Garage Pollutant Protection**

1. Place all air-handling equipment and ductwork outside the fire-rated envelope of the garage.
2. Tightly seal shared surfaces between the garage and conditioned spaces, including all of the following:
  - a. In conditioned spaces above the garage, seal all penetrations and all connecting floor and ceiling joist bays.
  - b. In conditioned spaces next to the garage, weather-strip all doors, install carbon monoxide detectors in rooms that share a door with the garage, seal all penetrations, and seal all cracks at the base of the walls.

#### **D. EQ Prerequisite 4 – Radon-Resistant Construction**

- New Construction
1. Provide a Passive or Active Radon Mitigation System per following requirements:
    - a. Install polyethylene sheeting or extruded polystyrene (XPS) insulation beneath concrete slabs, including basement floors. Ensure sheeting is in direct contact with the concrete

slab above. Install a capillary break at all crawlspace floors using  $\geq 6$  mil polyethylene sheeting, lapped 6 to 12 in.

- b. Under the polyethylene sheeting or extruded polystyrene (XPS) insulation installed to meet ENERGY STAR Water Management System Builder Checklist Item 1.3:
    - i. Install a 4 in. layer of 1/2 in. diameter or greater clean aggregate; OR
    - ii. Install a 4 in. uniform layer of sand, overlain with either a layer of geotextile drainage matting throughout or strips of geotextile drainage matting along the perimeter installed according to the manufacturer's instructions.
  - c. A 3 or 4 in. diameter gas-tight vertical vent pipe, clearly labeled to conform with the radon-resistant standard used, e.g., "Radon Reduction System" or "Radon Pipe" or "Radon System." The vent pipe shall be connected to an open T-fitting in the aggregate layer (or connected to geotextile drainage matting according to the manufacturer's instructions) beneath the polyethylene sheeting, extending up through the conditioned spaces and terminating a minimum of 12 in. above the roof opening. For crawlspaces, install at least 5 ft. of horizontal perforated drain tile on either side of the T-fitting, attached to the vertical radon vent pipe beneath the sheeting and running parallel to the long dimension of the house.
  - d. Radon fan installed in the attic (i.e., an active system) OR an electrical receptacle installed in an accessible attic location near the radon vent pipe (i.e., a passive system) to facilitate future fan installation if needed.
2. The requirements for radon protection are automatically satisfied if the building is elevated by at least 2 feet (600 millimeters), with open air space between the building and ground. An enclosed vented crawlspace does not qualify. A garage under a building is an acceptable alternative.
  3. Foundation air sealing with polyurethane caulk or the equivalent at all slab openings, penetrations and control or expansion joints.

#### **E. EQ Prerequisite 5 – Air Filtering**

1. Install air filters with a minimum efficiency reporting value (MERV) of 8 or higher on all recirculating space conditioning systems, per ASHRAE 62.2–2010. Design ductwork and specify the central blower to account for the pressure drop across the filter. Air filter housings must be airtight to prevent bypass or leakage.
2. Non-ducted systems are exempt from the minimum MERV 8 requirements but must have an internal air filter in the air-handling unit.
3. Install air filters rated MERV 6 or higher for mechanically supplied outdoor air for systems with 10 feet (3 meters) of ductwork or more, per ASHRAE 62.2–2010, Section 6.7.

#### **F. EQ Prerequisite 6 – Environmental Tobacco Smoke**

Multifamily

1. Provide signage to:
  - a. prohibit smoking in common areas,
  - b. prohibit smoking within 25 feet of building entrances.
  - c. or prohibit smoking on the entire property.

#### **G. EQ Prerequisite 7 – Compartmentalization**

1. Compartmentalize each residential unit to minimize leakage between units. Minimize uncontrolled pathways for environmental tobacco smoke and other indoor air pollutants between units by sealing penetrations in walls, ceilings, and floors and by sealing vertical chases (including utility chases, garbage chutes, mail drops, and elevator shafts) adjacent to the units.
2. Weather-strip all doors in the residential units leading to common hallways to minimize air leakage into the hallway. Weather-strip all exterior doors and operable windows to minimize leakage from outdoors.
3. Demonstrate acceptable sealing of residential units by a blower door test. Follow the procedure described by RESNET or the ENERGY STAR Multifamily High Rise Program

Testing and Verification Protocols, Version 1.0, with an allowable maximum leakage of 0.30 cfm50 per square foot (0.07 cmm50 per square meter) of enclosure (i.e., all surfaces enclosing the apartment, including exterior and party walls, floors, and ceiling) for new construction buildings.

4. Third-party Testing is to be scheduled and conducted in conjunction with the final inspection. The contractor shall notify the Green Rater at least four (4) weeks prior to the anticipated date for such inspection. Contractor shall provide access to each unit and cooperate with conducting of the test. The following tests shall be conducted by Green Rater:
  - a. Air Infiltration Test (Blower door Test) – Mandatory – Measures air leakage through unit enclosure.

**H. EQ Credit 1.1 (option 1) – Enhanced Ventilation - Enhanced Local Exhaust**

1. Use one of the following strategies in every bathroom with a shower, bathtub, or spa (i.e., half-baths are exempt) to control the use of the local exhaust fan:
  - a. an occupancy sensor;
  - b. an automatic humidistat controller;
  - c. a continuously operating exhaust fan; or
  - d. a delay timer that operates the fan for at least 20 minutes

**I. EQ Credit 3.1 (option 1) – Balancing of H&C Distribution Systems - Multiple Zones**

1. Multifamily buildings whose average unit size is less than 1,200 square feet (110 square meters) automatically meet the requirements of this credit.

**J. EQ Credit 3.3 (option 3) – Balancing of H&C Distribution Systems - Pressure Balancing**

1. Facilitate for Green Rater or a Third-Party to test each bedroom for pressure difference of more than 3 Pa (0.012-inch w.c.) with respect to the main body of the house when doors are closed, and the air handler is operating on highest speed.

**K. EQ Credit 7 – Low Emitting Products**

1. In the interior of the home, use products that have been tested and found compliant with the California Department of Public Health Standard Method V1.1–2010, using CA Section 01350, Appendix B, New Single-Family Residence Scenario, for emissions testing guidance. At least 90% of a component must meet the requirements to earn credit.
  - a. For site-applied interior paints and coatings, meet the requirements of CA Section 01350.

<b>TABLE 1. Acceptable certifications for emissions and content requirements</b>		
<b>CERTIFICATION</b>	<b>TESTING STANDARD REFERENCED IN LEED</b>	<b>APPLICABLE CATEGORIES</b>
SCS Indoor Advantage Gold	CDPH Standard Method v1.1 ANSI/BIFMA M7.1-2011	General Emissions Evaluation (many product categories), Furniture
FloorScore	CDPH Standard Method v1.1	Flooring
Carpet and Rug Institute (CRI) Green Label Plus	CDPH Standard Method v1.1	Carpeting, carpet padding, adhesives
Greenguard Children and Schools	CDPH Standard Method v1.1	General Emissions Evaluation (many product categories including exterior applied products)
Collaborative for High Performance Schools (CHPS)	CDPH Standard Method v1.1	General Emissions Evaluation (many product categories)
CARB ULEF label	N/A	Composite Wood

**ENCLOSURES**

**New Construction**

- 1 LEED for Homes Scorecard and Credit Categories
- 2 Energy Star National Rater Design Review Checklist
- 3 Energy Star National Rater Field Checklist
- 4 Energy Star National HVAC Design Report
- 5 Energy Star National HVAC Commissioning Checklist
- 6 Energy Star Water Management System Builder Checklist

END OF SECTION



# Germantown Crossing Senior Housing Scorecard (ID: )

Project Address 1520 Germantown Street, Dayton, Ohio 45417, United States

Note: The information on this tab is READ-ONLY. To edit this information, see the Credit Category tabs.



Integrative Process		Preliminary	Y	2 of 2	M	0	Verified	2
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IPc	Integrative Process			2 of 2		0	Verified	2
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Location and Transportation		Preliminary	Y	12 of 15	M	0	Verified	12
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LTP	Floodplain Avoidance			Required			Verified	
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Performance Path

LTc	LEED for Neighborhood Development			0 of 15		0		
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Prescriptive Path

LTc	Site Selection			7 of 8		0	Verified	7
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LTc	Compact Development			3 of 3		0	Verified	3
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LTc	Community Resources			1 of 2		0	Verified	1
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LTc	Access to Transit			1 of 2		0	Verified	1
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Sustainable Sites		Preliminary	Y	2 of 7	M	0	Verified	2
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SSp	Construction Activity Pollution Prevention			Required			Not Verified	
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SSp	No Invasive Plants			Required			Not Verified	
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SSc	Heat Island Reduction			0 of 2		0		
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SSc	Rainwater Management			0 of 3		0		
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SSc	Nontoxic Pest Control			2 of 2		0	Verified	2
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Water Efficiency		Preliminary	Y	3 of 12	M	1	Verified	0
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WEp	Water Metering			Required			Not Verified	
-----	----------------	--	--	----------	--	--	--------------	--

Performance Path

WEc	Total Water Use			0 of 12		0		
-----	-----------------	--	--	---------	--	---	--	--

Prescriptive Path

WEc	Indoor Water Use			3 of 6		0		
-----	------------------	--	--	--------	--	---	--	--

WEc	Outdoor Water Use			0 of 4		1		
-----	-------------------	--	--	--------	--	---	--	--



Energy and Atmosphere		Preliminary	Y	25 of 38	M	3	Verified	25
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EAp	Minimum Energy Performance			Required			Not Verified	
-----	----------------------------	--	--	----------	--	--	--------------	--

EAp	Energy Metering			Required			Not Verified	
-----	-----------------	--	--	----------	--	--	--------------	--

EAp	Education of the Homeowner, Tenant or Building Manager			Required			Not Verified	
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Performance Path

EAc	Annual Energy Use			25 of 29		0	Verified	25
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Performance and Prescriptive Paths

EAc	Efficient Hot Water Distribution System			0 of 5		2		
-----	---	--	--	--------	--	---	--	--

EAc	Advanced Utility Tracking			0 of 2		0		
-----	---------------------------	--	--	--------	--	---	--	--

EAc	Active Solar-Ready Design			0 of 1		0		
-----	---------------------------	--	--	--------	--	---	--	--

EAc	HVAC Start-Up Credentialing			0 of 1		1		
-----	-----------------------------	--	--	--------	--	---	--	--

Prescriptive Path

EAp	Home Size			Required			Not Verified	
-----	-----------	--	--	----------	--	--	--------------	--

EAc	Building Orientation for Passive Solar			0 of 3		0		
-----	--	--	--	--------	--	---	--	--

EAc	Air Infiltration			0 of 2		0		
-----	------------------	--	--	--------	--	---	--	--

EAc	Envelope Insulation			0 of 2		0		
-----	---------------------	--	--	--------	--	---	--	--

EAc	Windows			0 of 3		0		
-----	---------	--	--	--------	--	---	--	--

EAc	Space Heating & Cooling Equipment			0 of 4		0		
-----	-----------------------------------	--	--	--------	--	---	--	--

EAc	Heating & Cooling Distribution Systems			0 of 3		0		
-----	--	--	--	--------	--	---	--	--

EAc	Efficient Domestic Hot Water Equipment			0 of 3		0		
-----	--	--	--	--------	--	---	--	--

EAc	Lighting			0 of 2		0		
-----	----------	--	--	--------	--	---	--	--

EAc	High-Efficiency Appliances			0 of 2		0		
-----	----------------------------	--	--	--------	--	---	--	--

EAc	Renewable Energy			0 of 4		0		
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Materials and Resources		Preliminary	Y	3.5 of 10	M	0.5	Verified	1
MRp	Certified Tropical Wood	Required					Not Verified	
MRp	Durability Management	Required					Not Verified	
MRC	Durability Management Verification		1 of 1		0			
MRC	Environmentally Preferable Products		1.5 of 4		0			
MRC	Construction Waste Management		0 of 3		0			
MRC	Material-Efficient Framing		1 of 2		0.5			1



Indoor Environmental Quality		Preliminary	Y	7.5 of 16	M	1.5	Verified	4
EQp	Ventilation	Required					Not Verified	
EQp	Combustion Venting	Required					Not Verified	
EQp	Garage Pollutant Protection	Required					Not Verified	
EQp	Radon-Resistant Construction	Required					Not Verified	
EQp	Air Filtering	Required					Not Verified	
EQp	Environmental Tobacco Smoke	Required					Not Verified	
EQp	Compartmentalization	Required					Not Verified	
EQc	Enhanced Ventilation		1 of 3		0			1
EQc	Contaminant Control		0 of 2		1			
EQc	Balancing of Heating and Cooling Distribution Systems		2 of 3		0			1
EQc	Enhanced Compartmentalization		0 of 1		0			
EQc	Combustion Venting		2 of 2		0			
EQc	Enhanced Garage Pollutant Protection		2 of 2		0			2
EQc	Low-Emitting Products		0.5 of 3		0.5			



Innovation		Preliminary	Y	3 of 6	M	1	Verified	2
INp	Preliminary Rating	Required					Verified	
INc	Innovation		2 of 5		1			1
INc	LEED Accredited Professional		1 of 1		0			1



Regional Priority		Preliminary	Y	1 of 4	M	3	Verified	1
RPC	Regional Priority		1 of 4		3			1

**Point Floors**

The project earned at least 8 points total in Location and Transportation and Energy and Atmosphere	<input type="text" value="Yes"/>
The project earned at least 3 points in Water Efficiency	<input type="text" value="No"/>
The project earned at least 3 points in Indoor Environmental Quality	<input type="text" value="Yes"/>

Total	Preliminary	Y	59 of 110	M	10	Verified	49
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Certification Thresholds Certified: 40-49, Silver: 50-59, Gold: 60-79, Platinum: 80-110

# Integrative Process

Preliminary Y 2 Maybe 0 Verified 2

## IP Credit Integrative Process

Up to 2 points

Exemplary Performance: Achieve all three options

Preliminary Y  M  Verified

### Option 1. Integrative Project Team (1 point)

Y  M  V

Team members, in addition to the builder and verification team, include capabilities in at least three of the following skill sets:  
 architecture or residential building design;  
 mechanical or energy engineering;  
 building science or performance testing;  
 green building or sustainable design; and  
 civil engineering, landscape architecture, habitat restoration, or land-use planning.

All team members referenced above were involved in at least three of the following phases of the design and construction process:  
 conceptual or schematic design;  
 LEED planning;  
 preliminary design;  
 energy and envelope systems analysis or design;  
 design development;  
 final design, working drawings or specifications;  
 and construction.

Meetings were conducted with the project team at least monthly to review project status, introduce new team members to project goals, discuss problems, formulate solutions, review responsibilities, and identify next steps.

AND/OR

### Option 2. Design Charrette (1 point)

Y  M  V

A full-day workshop (or two half-day workshops) was conducted with the project team, as defined in Option 1, no later than the design development phase.

Date(s)  
 Duration

AND/OR

### Option 3. Trades Training (1 point)

Y  M  V

At least eight hours of training on the green aspects of the project and how the trades can contribute to achieving each LEED for Homes prerequisite and attempted credit was conducted before construction but after trades have been hired for the project.

Date(s)  
 Duration  
 Trainer

## Location and Transportation

Preliminary Y 12

Maybe 0

Verified 12

### LT Prerequisite Floodplain Avoidance

Required

Required

Verified

Y

Select one of the following:

True The project is not built on land within a flood hazard area.

The project is built on land within a flood hazard area and in accordance with flood provisions.

The project is built on land within a flood hazard area and is a previously developed building and hardscape.

### **Performance Path**

### LT Credit LEED for Neighborhood Development

15 points

Preliminary Y

M

Verified

- Name of LEED for Neighborhood Development project
- LEED ND project ID number
- Rating system and version
- LEED ND certification date

**Prescriptive Path**

**LT Credit Site Selection**

Up to 8 points

**Preliminary** Y

M

**Verified** V

*Exemplary Performance: Earn all 9 points*

**Option 1. Sensitive Land Protection (3-4 points)**

Y

M

V

**Path 1. Previously Developed (4 points)**

Y

M

V

<input type="text" value="1.69"/>	Total buildable land area (acre or sq ft)
<input type="text" value="1.69"/>	Previously developed buildable land area (acre or sq ft)
<input type="text" value="100.00%"/>	Percentage of lot previously developed (%)

OR

**Path 2. Avoidance of Sensitive Land (3 points)**

Y

M

V

All new buildings, hardscapes, roads, or parking areas of the project are located on land that meets the following criteria:

- Does not consist of prime farmland, unique farmland, or farmland of statewide or local importance.
- Was not public parkland prior to acquisition.
- Is not in a flood hazard area shown on a legally adopted flood hazard map or otherwise legally designated by the local jurisdiction or state.
- Is not on land specifically identified as habitat for species listed in the U.S. Endangered Species Act; the state's endangered species act; NatureServe GH, G1, or G2 lists; or those listed under local equivalent standards (for projects outside the U.S.) that are not covered by NatureServe data.
- Is not on land within 50 ft (15 m) of wetlands or within the setback distance from wetlands prescribed by local, state or national regulations, whichever is more stringent.
- Is not on land within 100 ft (30 m) of water bodies, including seas, lakes, rivers, streams and tributaries.

AND/OR

**Option 2. Infill Development (2 points)**

Y

M

V

Percent of land within a 1/2 mile (800 meters) from the project boundary that is previously developed

*Alternatively, for projects within city limits of towns with populations less than 20,000*

Percent of land adjacent to the project boundary that is previously developed

AND/OR

**Option 3. Open Space (1 point)**

Y

M

V

Select one of the following:

- Built within 1/2 mile (800 meters) of open space that is at least 3/4 acres (0.3 hectares)
- Create publically available open space on the project site

AND/OR

**Option 4. Street Network (1 point)**

Y

M

V

Qualifying intersection density (intersections per square mile)

AND/OR

**Option 5. Bicycle Network and Storage (1 point)**

Y  M  V

**Bicycle Network**

Select one of the following. The project has a functional entry and/or bicycle storage within 200 yd (180 m) of a bicycle network that connects to:

- At least 10 uses
- A school or employment center
- A bus rapid transit stops, rail stations, and/or ferry terminals

**Bicycle Storage for Multifamily Buildings**

- Number of building occupants
- Number of residential units
- Number of short-term spaces provided
- Number of short-term spaces required
- Number of long-term spaces provided
- Number of long-term spaces required

**Bicycle Storage for Single Family Homes**

- The project is a single family home with garage.

**LT Credit Compact Development**

Up to 3 points

**Preliminary** Y  M  **Verified**

*Exemplary Performance for Single and Multifamily Lowrise Only: 35 DU/acre (86.5 DU/hectare)*

- Total project boundary area (acre)
- Buildable land area (acre)
- Number of dwelling units
- DU/acre of buildable land

**LT Credit Community Resources**

Up to 2 points

**Preliminary** Y  M  **Verified**

*Exemplary Performance: 16 uses for 1/2 point, 20 uses for 1 point.*

- Number of community resources within a 1/2 mile (800 meters) walking distance

**LT Credit Access to Transit**

Up to 2 points

**Preliminary** Y  M  **Verified**

*Exemplary Performance: For multiple transit types, 720 weekday trips and 432 weekend trips; For commuter rail or ferry, 120 weekday trips.*

*For projects with multiple transit types*

- Number of weekday trips
- Number weekend day trips

*For projects with commuter rail or ferry service only*

- Number of weekday trips

## Sustainable Sites

Preliminary Y 2

Maybe 0

Verified 2

### SS Prerequisite Construction Activity Pollution Prevention

Required

Required

Verified

N

Confirm all of the following measures were implemented on the project, as applicable:

- True Stockpiled and protected disturbed topsoil from erosion.
- True Controlled the path and velocity of runoff with silt fencing or comparable measures.
- True Protected on-site storm sewer inlets, streams, and lakes with straw bales, silt fencing, silt sacks, rock filters, or comparable measures.
- True Provided swales to divert surface water from hillsides.
- True Used tiers, erosion blankets, compost blankets, filter socks, berms, or comparable measures to stabilize soils in any area with a slope of 15% (6.6:1) or more that was disturbed during construction.
- True Prevented air pollution from dust and particulate matter.

*For construction sites larger than 1 acre*

Select one of the following:

- True The project team created an implemented an Erosion and Sedimentation Control (ESC) plan that conforms to the requirements of the 2012 U.S. Environmental Protection Agency Construction General Permit (CGP).
- True The project team created an implemented an Erosion and Sedimentation Control (ESC) plan that conforms to local standards and codes, which are as or more stringent than the 2012 EPA Construction General Permit (CGP).

### SS Prerequisite No Invasive Plants

Required

Required

Verified

N

- True No invasive plant species have been introduced into the landscape.

### SS Credit Heat Island Reduction

Up to 2 points

Preliminary Y

0

M

0

Verified

0

#### Option 1. Shading and Option 2. Nonabsorptive Materials (1-2 points)

##### *Hardscapes*

24207	Total hardscape area (driveways, walkways, patios, etc.) (sq ft)
0	Area of shaded hardscapes (sq ft)
0	Area of unshaded paving materials with an initial SR value of at least 0.33 (sq ft)
0	Area of unshaded vegetation in open pavers (sq ft)
24207	Remaining hardscape area (not earning credit) (sq ft)

##### *Roof*

17803	Total roof area (sq ft)
0	Area of ENERGY STAR qualified roof (sq ft)
0	Area of vegetated roof (sq ft)
17803	Remaining roof area (not earning credit) (sq ft)

- 0.0% Percentage of area with shading or nonabsorptive material (%)

**SS Credit Rainwater Management**

Up to 3 points

Preliminary Y  M  Verified

Exemplary Performance: For Case 1, manage 100% of all stormwater on-site.

**Case 1. Low Impact Development (1-3 points)**

Y  M  V

*Site Characteristics*

Total lot area (sq ft)

*Roof*

Total roof area (sq ft)

Vegetated roof area (sq ft)

Roof area directed to a qualifying infiltration feature (sq ft)

Remaining roof area (not earning credit) (sq ft)

*Non-roof Site Area*

Total landscape softscape area (sq ft)

Total hardscape area (driveways, walkways, patios, etc.) (sq ft)

Permeable paving (sq ft)

Qualifying open pavers (sq ft)

Hardscapes directed to qualifying infiltration features (sq ft)

Remaining hardscape area (not earning credit) (sq ft)

*Qualifying area, as a percentage of total lot area*

Qualifying area, as percentage of total lot area (%)

*Reduction of total impermeable area*

Total impermeable area of the project (sq ft)

Reference home size (sq ft)

Impermeable area as a percentage of reference home size

OR

**Case 2. NPDES Projects (2-3 points)**

Y  M  V

Percentile rainfall event



**SS Credit Nontoxic Pest Control**

Up to 2 points

Preliminary Y

2

M

0

Verified

2

*Exemplary Performance: Projects that achieve 2 points can earn another ½ point for each additional strategy, up to a total of 1 point.*

Select all of the following that have been included in the project.

Install a steel mesh barrier termite control system. (1 point)

Install a physical termite barrier system (e.g., basaltic rock) approved by code. (1 point)

For below-grade walls, use solid concrete foundation walls, masonry walls with a course of solid block bond beam, or concrete-filled block. (0.5 point)

Install post-tension slabs. (0.5 point)

Treat all cellulosic structural material (e.g., wood framing) with a registered pesticide containing borates, following the manufacturer's directions for preconstruction treatment. (0.5 point)

Use noncellulosic material for all structural elements. (0.5 point)

Install ports or openings for all plumbing elements that penetrate the slab, to allow access for inspection and treatment of pest infestations. (0.5 point)

Install a registered termite bait system and provide for ongoing maintenance as required by the manufacturer. (0.5 point)

Design a minimum 6-inch (150 millimeters) inspection space between the surface of the planned landscape grade and nonmasonry siding. (0.5 point)

Seal all external cracks, joints, penetrations, edges, and entry points with appropriate caulking. Install rodent- and corrosion-proof screens (e.g., copper or stainless steel mesh) on all openings greater than ¼ inch (6 millimeters), except where code prohibits their installation. (0.5 point)

Design discharge points for rain gutters, air-conditioning condensation lines, steam vent lines, or any other moisture source such that discharge is at least 24 inches (600 millimeters) from the foundation. (0.5 point)

Design landscape features to provide a minimum 18-inch (450 millimeters) space between the exterior wall and any plantings. (0.5 point)

*For multifamily projects*

Develop an integrated pest management policy. The policy must include guidance for residents on pesticide use, housekeeping and prompt reporting of pest problems and incorporate policy in the Homeowner Education Manual. (Required)

# Water Efficiency

Preliminary Y 3      Maybe 1      Verified 0

## WE Prerequisite Water Metering

Required Required Verified

**Case 2. Multifamily** V

- A water meter or submeter is installed for each unit.
- A water meter or submeter is installed for the whole building.

### Performance Path

## WE Credit Total Water Use

Up to 12 points Preliminary Y  M  Verified

*Exemplary Performance: 70% reduction of indoor and outdoor water consumption*

Total reduction of indoor and outdoor water consumption as calculated in the [Water Reduction Calculator](#) (%)

*For single family projects*

The water pressure does not exceed 60 psi (415 kPa). There are no detectable water leaks. Any installed water softeners are demand initiated.

### Prescriptive Path

## WE Credit Indoor Water Use

Up to 6 points Preliminary Y  M  Verified

**Case 2. Multifamily and Midrise** Y  M  V

*Note: No additional credit is awarded if the fixtures and fittings in non-unit spaces are more efficient than those of in-unit spaces.*

Meet any of the following for in-unit spaces and non-unit spaces:

Lavatory Faucet (1-2 points)

- All installed lavatory faucets and/or faucet aerators are WaterSense labeled.
- Average rated flow volume across all lavatory faucets (gpm)

Showerheads (1-2 points)

- All installed showerhead fixtures and fittings are WaterSense labeled.
- Average rated flow volume per shower compartment (gpm)

Toilets (1 point)

- All installed toilet fixtures and fittings are WaterSense labeled.
- Average rated flush volume across all toilets (gpf)

Clothes Washers (1 point)

- All clothes washers are ENERGY STAR qualified or performance equivalent

## WE Credit Outdoor Water Use

Up to 4 points Preliminary Y  M  Verified

- Turf grass area as a percentage of total landscape softscape area (%)
- Native or adapted plant area as a percentage of total landscape softscape area (%)

# Energy and Atmosphere

Preliminary Y 25

Maybe 3

Verified 25

## EA Prerequisite Minimum Energy Performance

Required

Required

Verified

N

### 1. ENERGY STAR for Homes version 3

True ENERGY STAR version 3 checklists are complete

HERS index rating

ENERGY STAR HERS index target

OR

ENERGY STAR Builder Option Package has been followed and all requirements met.

### 2. ENERGY STAR Qualified Appliances

Select at least one of the following:

True ENERGY STAR refrigerator is installed.

ENERGY STAR dishwasher is installed.

ENERGY STAR clothes washer is installed.

### 3. Duct Runs

True All duct runs are fully ducted.

## EA Prerequisite Energy Metering

Required

Required

Verified

N

### Case 1. Single Family

V

A whole-house electric meter is installed.

A whole-house gas meter is installed.

OR

### Case 2. Multifamily

V

N

True Electric submeters are installed in each residential unit.

Whole building A whole-building gas meter or submeter for each residential unit is installed.

## EA Prerequisite Education of Homeowner, Tenant, or Building Manager

Required

Required

Verified

N

True An operations and maintenance manual, binder, or CD has been/will be provided to all individuals or organizations responsible for the maintenance of the home.

True A minimum one-hour walkthrough of the home with the occupants has been conducted.

**Performance Path**

**EA Credit Annual Energy Use**

Up to 29 points

Preliminary Y  M  Verified

Exemplary Performance: For Option 1, 100% reduction; For Option 2, -10 HERS index rating.

**Option 1. LEED Energy Budget (1-29 points)** Y  M  V

<input type="text" value="191.55"/>	LEED Energy Budget (MBtu/year)
<input type="text" value="84.23"/>	Annual energy consumption (MBtu/year)
<input type="text" value="56.0%"/>	Percent reduction below LEED Energy Budget (%)
<input type="text" value="25"/>	<b>Total Points</b>

OR

**Option 2. HERS Index with Home Size Adjuster (0.5-29 points)** Y  M  V

<input type="text" value="66"/>	HERS index rating
<input type="text" value=""/>	Number of bedrooms
<input type="text" value=""/>	Conditioned floor area of the house (sq ft)
<input type="text" value=""/>	ENERGY STAR for Homes, version 3, reference home floor area (sq ft)
<input type="text" value="11.5"/>	HSA points
<input type="text" value="9"/>	Points for achieving HERS index rating
<input type="text" value="20.5"/>	<b>Total (HSA points + Points for achieving HERS index rating)</b>

**Performance and Prescriptive Paths**

**EA Credit Efficient Hot Water Distribution System**

Up to 5 points

Preliminary Y  M  Verified

**Option 1. Efficient Hot Water Distribution (2 points)** Y  M  V

Note: Projects using heat traces that serve a single unit or house are awarded only half credit.

For projects using circulating systems

- Circulating pump does not operate continuously, is on a timer, or is on a water temperature sensor.
- Circulating pump is demand activated by a momentary contact switch, motion sensor, flow switch, door switch or voice command.
- After the pump starts, the controls allow the pump to operate until the water temperature in the return pipe rises not more than 10°F (6 °C) above the initial temperature of the water in the pipe. Controls limit the water temperature to a maximum of 105°F (40 °C). Controls limit pump operation to not more than 5 minutes per activation in the event that both means of shutting off the pump have failed.
- Circulating hot water systems have with an automatic or readily accessible manual switch to turn off the hot water circulating pump when not in use.

For projects using heat-traced piping systems

- Piping is insulated.

**Path 1. Maximum Allowable Pipe Length (2 points)** Y  M  V

<input type="text" value="46.00"/>	Pipe or tube length installed (ft)
<input type="text" value="1/4"/>	Nominal pipe size (in)
<input type="text" value="50"/>	Maximum pipe or tube length allowed for water heaters, boilers with no circulation loop or heat traced pipe or in multifamily buildings a central circulation loop or heat traced pipe (ft)
<input type="text" value="16"/>	Maximum pipe or tube length allowed for circulation loop or heat traced pipe serving a single unit or house (ft)

OR

**Path 2. Maximum Allowable Pipe Volume (2 points)** Y  M  V

- Volume of hot or tempered water from source to termination (oz)

OR

**Option 2. Performance Test (3 points)**

Y  M  V

*Note: Projects using heat traces that serve a single unit or house are awarded only half credit.*

*For projects using circulating systems*

- Circulating pump does not operate continuously, is on a timer, or is on a water temperature sensor.
- Circulating pump is demand activated by a momentary contact switch, motion sensor, flow switch, door switch or voice command.
- After the pump starts, the controls allow the pump to operate until the water temperature in the return pipe rises not more than 10°F (6 °C) above the initial temperature of the water in the pipe. Controls limit the water temperature to a maximum of 105°F (40 °C). Controls limit pump operation to not more than 5 minutes per activation in the event that both means of shutting off the pump have failed.
- Circulating hot water systems have with an automatic or readily accessible manual switch to turn off the hot water circulating pump when not in use.

*For projects using heat-traced piping systems*

- Piping is insulated.

*Note: Projects using heat traces that serve a single unit or house are awarded only half credit.*

**Case 1. Hot water source is a water heater or boiler with no circulation loop or heat traced pipe; or in multifamily buildings a central circulation loop or heat traced pipe.**

Y  M  V

- Meets WaterSense Labeled New Homes requirements
- Tested volume of water stored in piping (gal)

OR

**Case 2. Hot water source is a circulation loop or heat traced pipe serving a single unit or house**

Y  M  V

- Tested volume of water stored in piping (gal)

*For projects using heat-traced piping systems*

- Piping is insulated.

AND/OR

**Option 3. Pipe Insulation (2 points)**

Y  M  V

- R-4 Insulation R-value

**EA Credit Advanced Utility Tracking**

Up to 2 points

**Preliminary** Y  M  **Verified**

*Exemplary Performance: Meter separate energy usage information for at least four end uses.*

**Case 2. Multifamily**

Y  M  V

**Option 1. Electric and Water (1 point)**

Y  M  V

Select one of the following:

- A permanent energy-monitoring system that records at intervals of one hour or less has been installed in each unit.
- The project has an automatic in-ground irrigation system and landscaped irrigated area larger than 1,000 sq ft (93 sq m) and has installed a submeter to monitor all irrigation system components.

AND/OR

**Option 2. Third-Party Utility Reporting (1 point)**

Y  M  V

**Path 1. Whole-Building Master Meter**

Y  M  V

The building owner has shared all applicable utility data with USGBC via a USGBC-approved third-party.

OR

**Path 2. Individual Unit Meters**

Y  M  V

At least 50% of unit owners or occupants have shared all applicable utility data with USGBC via a USGBC-approved third-party.

**EA Credit Active Solar-Ready Design**

1 point

**Preliminary** Y  M  **Verified**

*Exemplary Performance: Achieve Option 1 and Option 2.*

**Option 1. Photovoltaic-Ready Design (1 point)**

Y  M  V

*Note: Projects that install a photovoltaic (PV) system that meets the requirements of EA Credit Renewable Energy are not eligible for this credit.*

The house meets EPA's solar photovoltaic specifications for a renewable energy-ready home.

AND/OR

**Option 2. Solar Direct Hot Water-Ready Design (1 point)**

Y  M  V

*Note: Projects that install a solar direct hot water (DHW) system that meets the requirements of EA Credit Efficient Domestic Hot Water Equipment are not eligible for this credit.*

Meets EPA's solar water heating specifications for a renewable energy-ready home.

**EA Credit HVAC Start-Up Credentialing**

1 point

**Preliminary** Y  M  **Verified**

Name of technician

Company of technician

Technician commissioning all heating, cooling, and ventilation systems has the following credential

## Materials and Resources

Preliminary Y 3.5 Maybe 0.5 Verified 1

### MR Prerequisite Certified Tropical Wood

Required Required Verified

All wood in the building is nontropical, reused or reclaimed, or certified by the Forest Stewardship Council, or USGBC-approved equivalent.

### MR Prerequisite Durability Management

Required Required Verified

ENERGY STAR for Homes, version 3, water management system checklist is collected from builder.

Confirm all of the following have been implemented on the project:

Nonpaper-faced backer board, or a product or coating over wallboard that meets standard ASTM D 3273 standard, was installed on the area above bathtub, spa or shower, and in areas behind fiberglass enclosures where wallboard is installed.

Water-resistant flooring was installed in the kitchen, bathroom(s), laundry room, spa area(s). No carpet was installed in these areas.

Water-resistant flooring was installed in entryways within 3 feet of exterior door(s).

A drain and drain pan, drain pan and automatic water shut-off or flow restrictors, or floor drain with floor sloped to drain was installed for all tank water heaters in or over living space.

A braided washer hose, drain and drain pan, drain pan and automatic water shut-off or flow restrictors, or floor drain with floor sloped to drain was installed for clothes washer in or over living space.

Conventional clothes dryers exhaust directly to outdoors.

### MR Credit Durability Management Verification

1 point Preliminary Y  M  Verified

Each measure in the ENERGY STAR for Homes, version 3, water management system builder checklist was verified by the verification team.

### MR Credit Environmentally Preferable Products

Up to 4 points Preliminary Y  M  Verified

*Exemplary Performance: For Option 2, achieve a minimum of 4 points to earn another 2 points for purchasing products that meet the requirements.*

**Option 1. Local Production** Preliminary Y  M  Verified

Select which the following were extracted, processed, and manufactured within 100 miles (160 km) of the project site:

<input type="text" value=""/>	Percentage of locally produced framing (%) (0.5 point)
<input type="text" value="50.00"/>	Percentage of locally produced aggregate for concrete and foundation (%) (0.5 point)
<input type="text" value=""/>	Percentage of locally produced drywall and interior sheathing (%) (0.5 point)

AND/OR

**Option 2. Environmentally Preferable Products**

Preliminary Y

M

Verified

Select the criteria met by at least 90% of the component:

No Floor Covering (2 points)	
Floor Covering (1 point)	
Insulation (1 point)	
Sheathing (1 point)	
Framing (1 point)	
Drywall (1 point)	For synthetic, 95% recycled content (pre-, post-, or combination)
Concrete (1 point)	
Roofing (1 point)	
Siding (1 point)	

Select criteria met for at least 3 of the following additional components by at least 90% of the component (1 point):

Doors	
Cabinets	
Counters	
Interior Trim	
Decking/Patio	
Windows	

**MR Credit Construction Waste Management**

Up to 3 points

Preliminary Y

M

Verified

*Exemplary Performance: For renovation projects, track and divert at least 50% of demolition waste.*

LEED Reference Home Baseline Waste (lbs)

Total Construction Waste (including recycled waste) (lbs)

Recycled Waste (lbs)

0.00  Project Construction Waste (lbs)

Percent reduction below baseline (%)



**MR Credit Material-Efficient Framing**

Up to 2 points

Preliminary Y

1

M

0.5

Verified

1

Exemplary Performance: Achieve a minimum of 2 points to earn up to 1/2 point for each additional requirement met.

Select one of the following for at least 90% of each component: (1 point)

- No more than one horizontal 2x top plate on walls by aligning studs with joists and roof rafters was installed.
- Window and door headers were placed in the rim joist.
- Raised (directly beneath the top plate), single-ply headers not more than 2 inches nominal thickness in a 2x4 wall or 4 inches nominal thickness in a 2x6 wall, were installed.
- Structural insulated panels (SIPs) were installed for walls.

Select at least 2 of the following for at least 90% of each component: (0.5 point)

- Headers were sized for actual loads.
- Maybe Ladder blocking or drywall clips were used.
- Maybe Two-stud corners or California corners were used.

Select all that apply for at least 90% of each component: (0.5 point each)

- Interior wall studs were spaced greater than 16 inches (400 mm) o.c.
- True Floor joists were spaced greater than 16 inches (400 mm) o.c.
- True Roof rafters were spaced greater than 16 inches (400 mm) o.c.

# Indoor Environmental Quality

Preliminary Y 7.5 Maybe 1.5 Verified 4

## EQ Prerequisite Ventilation

Required	Required	Verified	N
		V	N

### Case 2. Multifamily

#### Local Exhaust

Confirm all of the following have been implemented on the project:

- True Local exhaust systems meeting the requirements of ASHRAE Standard 62.2–2010, Sections 5 and 7 or local equivalent, whichever is more stringent, were installed in all bathrooms (including half-baths) and the kitchen.
- True Local exhaust systems exhaust air directly to the outdoors.
- True All bathroom exhaust fans are ENERGY STAR-labeled or an HRV or ERV is used.
- True For exhaust hood systems capable of exhausting in excess of 400 cubic feet per minute (188 liters per second), makeup air is provided at a rate approximately equal to the exhaust air rate. Makeup air systems have a means of closure and can be automatically controlled to start and operate simultaneously with the exhaust system.

#### Whole Unit Mechanical Ventilation

- True The project meets ASHRAE Standard 62.2-2010 Sections 4 and 7 or local equivalent, whichever is more stringent.

#### Non-Unit Spaces

- True The project meets the minimum requirements of ASHRAE Standard 62.1-2010 Sections 4 -7 or local equivalent, whichever is more stringent.
- The project is located in a nonattainment area for PM2.5. The project has installed MERV 11 or higher filters.
- The project is located in a nonattainment area for ozone.

## EQ Prerequisite Combustion Venting

Required	Required	Verified	N
			N

- The project has earned the EPA Indoor airPLUS label  
OR
- True No unvented combustion appliances were installed (ovens and ranges excluded).
- True A carbon monoxide (CO) monitor is installed on each floor, hard-wired with a battery backup.

*For projects with fireplaces or woodstoves installed*

- Provide doors that close or a solid glass enclosure.
- Closed-combustion, power-vented or passes BPI or RESNET combustion safety protocols

*For projects where space and water heating equipment involving combustion are installed*

Select one of the following:

- True Equipment is installed with closed combustion (i.e. sealed supply air and exhaust ducting)
- True Equipment is installed with power-vented exhaust
- Equipment is located in a detached utility building or open-air facility

**EQ Prerequisite Garage Pollutant Protection**

Required Required Verified N

- The project has earned the EPA Indoor airPLUS label
- OR
- True All air-handling equipment and ductwork is placed outside the fire-rated envelope of the garage.
- True Shared surfaces between the garage and conditioned spaces are tightly sealed.

**Conditioned Spaces Above Garage**

- N/A All penetrations and all connecting floor and ceiling joist bays are sealed.

**Conditioned Spaces Next to Garage**

- N/A All doors are weather-stripped.
- N/A Carbon monoxide detectors are installed in rooms that share a door with the garage
- N/A All penetrations and all cracks at the base of the walls are sealed.

**EQ Prerequisite Radon-Resistant Construction**

Required Required Verified N

*Exemplary Performance: For projects in radon zones 2 and 3, install a qualifying passive radon ventilation system.*

**EPA Indoor airPLUS label** V

- The project has earned the EPA Indoor airPLUS label

OR

**Case 1. New Construction** V

- 1 EPA radon zone

*For projects in EPA radon zone 1*

- True There is a capillary break per the Indoor airPLUS specifications.
- True An electrical outlet has been provided near vent piping in the attic to facilitate future fan installation.
- True A gas-tight vertical vent pipe extending up through the conditioned spaces and terminating above the roof opening has been installed.

OR

- The house is elevated by at least 2 feet (600 millimeters) with open air space between building and ground or there is a garage under the building.

OR

**Case 2. Renovation of Existing Building** V

- EPA radon zone

*For renovation projects in EPA radon zone 1 with no slab work being performed*

- Radon test results (pCi/L)
- If results are greater than 4 pCi/L, an active ventilation system has been installed.

**EQ Prerequisite Air Filtering**

Required Required Verified N

- The project has earned the EPA Indoor airPLUS label
- OR
- 8.00 MERV rating of filters on recirculating space conditioning systems
- 8.00 MERV rating of filters on mechanically supplied outdoor air systems with 10 ft (3 m) or more of ductwork

**EQ Prerequisite Environmental Tobacco Smoke**

Required

Required

Verified

*For multifamily projects*

Smoking is prohibited in all common areas of the building.

Smoking is prohibited outside the project building(s) except in designated smoking areas located at least 25 ft (7.5 m) from all entries, outdoor air intakes, and operable windows.

Signage communicating the smoking policy has been installed.

**EQ Prerequisite Compartmentalization**

Required

Required

Verified

*For multifamily and attached single-family projects*

Each residential unit has sealed penetrations through walls, ceilings, and floors and vertical chases adjacent to units.

All doors in the residential units leading to common hallways have weather-stripping.

All exterior doors and operable windows have weather-stripping.

<input type="text" value=""/>
<input type="text" value=""/>
<input type="text" value="0.00"/>

Blower door test results (cfm50)

Envelope enclosure area (sq ft)

Leakage per area of enclosure (cfm50/sq ft)

**EQ Credit Enhanced Ventilation**

Up to 3 points

Preliminary

Y

M

Verified

**Option 1. Enhanced Local Exhaust (1 point)**

Y

M

V

Bathroom exhaust fan control type in every bathroom with a shower, bathtub, or spa

AND/OR

**Option 2. Enhanced Whole-House Ventilation (2 points)**

Y

M

V

 A balanced whole-house ventilation system was designed and installed that meets ASHRAE 62.2-2010 sections 4 and 7 in each home or unit. The system does not exceed ASHRAE 62.2-2010 requirements by more than 10%.**EQ Credit Contaminant Control**

Up to 2 points

Preliminary

Y

M

Verified

*Exemplary Performance: Achieve a minimum of 2 1/2 points to earn another 1/2 point.***Option 1. Walk-off Mats (0.5 point)**

Y

M

V

For all primary entryways, a permanent walk-off mat that is at least 4 feet (1.2 meters) long and allows access for cleaning has been installed.

*For multifamily projects*

For exterior entryways in common areas, permanent systems that are at least 10 feet (3 meters) long have been installed.

AND/OR

**Option 2. Shoe Removal and Storage (0.5 point)**

Y  M  V

A shoe removal and storage space is near the primary entryway.

No conventional carpet is installed in shoe removal and storage area.

AND/OR

**Option 3. Preoccupancy Flush (0.5 point)**

Y  M  V

The project has earned the EPA Indoor airPLUS label  
OR

True At installation, all permanent ducts and vents were sealed to minimize contamination from construction.

After construction ends and before occupancy

True Any dust and debris was removed from ducts.

True The home was flushed out for 48 hours, with all windows open, a fan run continuously or all HVAC fans and exhaust fans.

AND/OR

**Option 4. Air Testing (1 point)**

Y  M  V

The building was tested for indoor air contaminants and maximum concentrations were not exceeded.

**EQ Credit Balancing of Heating and Cooling Distribution Systems**

Up to 3 points

**Preliminary** Y  M  **Verified**

**Case 1. Forced-Air Systems**

Y  M  V

**Option 1. Multiple Zones (1 point)**

Y  M  V

A system with at least two space-conditioning zones with independent thermostatic controls has been installed.  
OR

True The project is a single family home less than 800 sq ft (74 sq m) or a multifamily building whose average unit size is less than 1,200 sq ft (110 sq m).

AND/OR

**Option 2. Supply Air-Flow Testing (1 point)**

Y  M  V

The supply air-flow rates are within +/- 20% (or +/- 25 cfm or 11 lps) of calculated values from ACCA Manual J.

AND/OR

**Option 3. Pressure Balancing (1 point)**

Y  M  V

True The pressure differential between bedroom and rest of the house is less than 3 Pa.

OR

**Case 2. Radiative Systems**

Y  M  V

**Option 1. Multiple Zones (1 point)**

Y  M  V

A system with at least two zones with independent thermostatic controls has been installed  
 Each zone has a separate loop and pump controlled automatically by a thermostat control.  
OR

The project is a single family home less than 800 sq ft (74 sq m) or a multifamily building whose average unit size is less than 1,200 sq ft (110 sq m).

AND/OR

**Option 2. Room-by-Room Controls (2 points)**

Y  M  V

Room-by-room thermostatic controls are installed.

**EQ Credit Enhanced Compartmentalization**

1 point

**Preliminary** Y  M  **Verified**

Leakage per area of enclosure (cfm50/sq ft)

**EQ Credit Combustion Venting**

Up to 2 points

**Preliminary** Y  M  **Verified**

**Option 1. No Fireplace or Woodstove (2 points)**

Y  M  V

No fireplaces or woodstoves have been installed.

OR

**Option 2. Enhanced Combustion Venting Measures (1 point)**

Y  M  V

The project has earned the EPA Indoor airPLUS label

OR

EPA qualified wood- or pellet-burning fireplaces with either power or direct venting have been installed.

A natural gas, propane, or alcohol stove approved by a safety testing facility and has power or direct venting has been installed.

A natural gas, propane, or alcohol stove has a permanently fixed glass front or gasketed door and an electronic pilot.

**EQ Credit Enhanced Garage Pollutant Protection**

Up to 2 points

**Preliminary** Y  M  **Verified**

**Case 2. Multifamily**

Y  M  V

**Option 1. Exhaust Fan in Multicar Garage (1 point)**

Y  M  V

Meet all of the following:

All of the requirements in ASHRAE 62.1-2010 for garage ventilation have been met.

The garage has sufficient exhaust to create negative pressure with respect to adjacent spaces with the doors to the garage closed.

Self-closing doors have been installed. Deck-to-deck partitions or a hard lid ceiling have been installed.

The exhaust fan either runs continuously or is on a carbon monoxide sensor that turns on the fan when ambient CO levels reach 35 ppm.

OR

**Option 2. Exhaust Fan in Small Garage (1 point)**

Y  M  V

Meet all of the following:

An exhaust fan that meets ENERGY STAR minimum efficacy levels (cfm/W) has been installed.

Installed direct-exhaust fans are 100 cfm (47 lps) or greater.

Installed ducted exhaust fans are 130 cfm (61 lps) or greater.

The exhaust fan either runs continuously or has an automatic timer control linked to an occupant sensor, a light switch, a garage door opening-closing mechanism, or a carbon monoxide sensor that turns on the fan when ambient CO levels reach 35 ppm, or equivalent.

The exhaust fan has an automatic timer set to provide at least three air changes each time the fan is turned on.

OR

**Option 3. No Garage, or Detached Garage (2 points)**

Y

M

V

True

No garage has been constructed.

A detached garage has been constructed.

**EQ Credit Low-Emitting Products**

Up to 3 points

**Preliminary**

Y

M

**Verified**

Select all that apply. At least 90% of a component must meet the requirement:

True

Site-applied interior paints and coatings have been tested and meet the requirements of CA Section 01350. (0.5 point)

True

Flooring has been tested and meets the requirements of CA Section 01350. (0.5 point)

Insulation has been tested and meets the requirements of CA Section 01350. (0.5 point)

Site-applied adhesives and sealants have been tested and meet the requirements of CA Section 01350. (0.5 point)

Composite wood products have been tested and meet the California Air Resources Board requirements for ultra-low-emitting formaldehyde (ULEF) resins or no-added formaldehyde based resins. (1 point)

# Innovation

Preliminary Y 3      Maybe 1      Verified 2

## IN Prerequisite Preliminary Rating

Required Required Verified

Preliminary rating and meeting are complete.

## IN Credit Innovation

To achieve all five innovation points, a project team must achieve at least one pilot credit, at least one innovation credit and no more than two exemplary performance credits.

Up to 5 points Preliminary Y  M  Verified

**Option 1. Innovation (1 point)** Y  M  V

Describe the intent of the proposed innovation credit.

AND/OR

**Option 2. Pilot (1 point)** Y  M  V

Pilot credit name

AND/OR

**Option 3. Additional Strategies (0.5-3 points)** Y  M  V

*Exemplary Performance: 1-2 points*

Strategy  
 Credit name

Strategy  
 Credit name

Strategy  
 Credit name

Strategy  
 Credit name

Strategy  
 Credit name

Strategy  
 Credit name

## IN Credit LEED Accredited Professional

1 point Preliminary Y  M  Verified

Name of credential holder



## Regional Priority

Preliminary Y 1      Maybe 3      Verified 1

### RP Credit Regional Priority

Up to 4 points

Preliminary Y  M  Verified

Regional priority credits may be found on [www.usqbc.org/rpc](http://www.usqbc.org/rpc).

Regional Priority Credit Name	Required Threshold
LT Community resources (maybe)	2
MR Material-efficient framing (maybe)	3
SS Heat island reduction (no)	2
LT Compact development (YES)	3
SS Rainwater management (no)	2
LT Access to transit (maybe)	2



# National Rater Design Review Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

Home Address: _____ City: _____ State: _____ Permit Date: _____		
<b>1. Partnership Status</b>	<b>Must Correct</b>	<b>Rater <sup>1</sup> Verified</b>
1.1 Rater has verified that builder is an ENERGY STAR partner using <a href="http://energystar.gov/partnerlocator">energystar.gov/partnerlocator</a>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 Rater has verified that HVAC contractor holds credential required to complete National HVAC Commissioning Checklist, unless all equipment to be installed in home to be certified is an exempted type, in which case check "N/A" <sup>2</sup> <input type="checkbox"/> N/A HVAC Contractor Company Name: _____	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. High-Performance Fenestration</b>		
2.1 Specified fenestration meets or exceeds 2009 IECC requirements <sup>3</sup>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. High-Performance Insulation</b>		
3.1 Specified ceiling, wall, floor, and slab insulation levels comply with one of the following options:	<input type="checkbox"/>	<input type="checkbox"/>
3.1.1 Meets or exceeds 2009 IECC levels <sup>4,5,6</sup> <b>OR</b> ;	-	-
3.1.2 Achieves $\leq 133\%$ of the total UA resulting from the U-factors in 2009 IECC Table 402.1.3, per guidance in Footnote 4d, AND specified home infiltration does not exceed the following: <sup>5,6</sup> 3 ACH50 in CZs 1, 2      2.5 ACH50 in CZs 3, 4      2 ACH50 in CZs 5, 6, 7      1.5 ACH50 in CZ 8	-	-
<b>4. Review of National HVAC Design Report <sup>7</sup></b>		
4.1 National HVAC Design Report collected for records, with no items left blank	<input type="checkbox"/>	<input type="checkbox"/>
4.2 National HVAC Design Report reviewed by Rater for the following parameters (National HVAC Design Report Item # in parenthesis):		
4.2.1 Cooling season and heating season outdoor design temperatures used in loads (3.3) are within the limits defined at <a href="http://energystar.gov/hvacdesigntemps">energystar.gov/hvacdesigntemps</a> for the State and County, or US Territory, where the home will be built, or the designer has provided an allowance from EPA to use alternative values <sup>8</sup>	<input type="checkbox"/>	<input type="checkbox"/>
4.2.2 Number of occupants used in loads (3.4) is within $\pm 2$ of the home to be certified <sup>9</sup>	<input type="checkbox"/>	<input type="checkbox"/>
4.2.3 Conditioned floor area used in loads (3.5) is between 100 sq. ft. smaller and 300 sq. ft. larger than the home to be certified	<input type="checkbox"/>	<input type="checkbox"/>
4.2.4 Window area used in loads (3.6) is between 15 sq. ft. smaller and 60 sq. ft. larger than the home to be certified, or, for homes to be certified with > 500 sq. ft. of window area, between 3% smaller and 12% larger	<input type="checkbox"/>	<input type="checkbox"/>
4.2.5 Predominant window SHGC used in loads (3.7) is within 0.1 of predominant value in the home to be certified <sup>10</sup>	<input type="checkbox"/>	<input type="checkbox"/>
4.2.6 Sensible, latent, & total heat gain are documented (3.10 - 3.12) for the orientation of the home to be certified <sup>11</sup>	<input type="checkbox"/>	<input type="checkbox"/>
4.2.7 The variation in total heat gain across orientations (3.13) is $\leq 6$ kBtuh <sup>11</sup>	<input type="checkbox"/>	<input type="checkbox"/>
4.2.8 Cooling sizing % (4.13) is within the cooling sizing limit (4.15) selected by the HVAC designer	<input type="checkbox"/>	<input type="checkbox"/>
Rater Name: _____ Date of Review: _____		
Rater Signature: _____ Rater Company Name: _____		



# National Rater Design Review Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### Footnotes

1. The term 'Rater' refers to the person completing the third-party inspections required for certification. This person shall: a) be a certified Home Energy Rater, Rating Field Inspector, or an equivalent designation as determined by a Verification Oversight Organization such as RESNET; and, b) have attended and successfully completed an EPA-recognized training class. See [energystar.gov/newhomestraining](http://energystar.gov/newhomestraining).
2. HVAC contractors must be credentialed by an EPA-recognized HVAC Quality Installation Training and Oversight Organization (H-QUITO) if a split air conditioner, unitary air conditioner, air-source heat pump, or water-source (i.e., geothermal) heat pump up to 65 kBtuh with a forced-air distribution system (i.e., ducts) or a furnace up to 225 kBtuh with a forced-air distribution system (i.e., ducts) will be installed in the home to be certified. For all other permutations of equipment (e.g., boilers, mini-split / multi-split systems) and distribution systems, a credential is not required. An explanation of this credentialing process and links to H-QUITOs, which maintain lists of credentialed contractors, can be found at [energystar.gov/newhomeshvac](http://energystar.gov/newhomeshvac).
3. All windows, doors and skylights shall meet or exceed the component U-factor and SHGC requirements specified in 2009 IECC Table 402.1.1. If no NFRC rating is noted on the window or in product literature (e.g., for site-built fenestration), select the U-factor and SHGC value from Tables 4 and 10, respectively, in 2013 ASHRAE Fundamentals, Chapter 15. Select the highest U-factor and SHGC value among the values listed for the known window characteristics (e.g., frame type, number of panes, glass color, and presence of low-e coating). Note that the U-factor requirement applies to all fenestration while the SHGC only applies to the glazed portion. The following exceptions apply:
  - a. An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements;
  - b. An area-weighted average of fenestration products  $\geq 50\%$  glazed shall be permitted to satisfy the SHGC requirements;
  - c. 15 square feet of glazed fenestration per dwelling unit shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above;
  - d. One side-hinged opaque door assembly up to 24 square feet in area shall be exempt from the U-factor requirements and shall be excluded from area-weighted averages calculated using a) and b), above;
  - e. Fenestration utilized as part of a passive solar design shall be exempt from the U-factor and SHGC requirements, and shall be excluded from area-weighted averages calculated using a) and b), above. Exempt windows shall be facing within 45 degrees of true South and directly coupled to thermal storage mass that has a heat capacity  $> 20 \text{ btu} / \text{ft}^3 \times ^\circ\text{F}$  and provided in a ratio of at least 3 sq. ft. per sq. ft. of South facing fenestration. Generally, thermal mass materials will be at least 2 in. thick.In PHIUS+ or PHI certified homes, where triple-glazed window assemblies with thermal breaks / spacers between the panes are used, such windows meet the intent of Item 2.1 and shall be excluded when assessing compliance of a) through e), above.
4. Specified levels shall meet or exceed the component insulation levels in 2009 IECC Table 402.1.1. The following exceptions apply:
  - a. Steel-frame ceilings, walls, and floors shall meet the insulation levels of 2009 IECC Table 402.2.5. In CZ 1 and 2, the continuous insulation requirements in this table shall be permitted to be reduced to R-3 for steel-frame wall assemblies with studs spaced at 24 in. on center. This exception shall not apply if the alternative calculations in d) are used;
  - b. For ceilings with attic spaces, R-30 shall satisfy the requirement for R-38 and R-38 shall satisfy the requirement for R-49 wherever the full height of uncompressed insulation at the lower R-value extends over the wall top plate at the eaves. This exemption shall not apply if the alternative calculations in d) are used;
  - c. For ceilings without attic spaces, R-30 shall satisfy the requirement for any required value above R-30 if the design of the roof / ceiling assembly does not provide sufficient space for the required insulation value. This exemption shall be limited to 500 sq. ft. or 20% of the total insulated ceiling area, whichever is less. This exemption shall not apply if the alternative calculations in d) are used;
  - d. An alternative equivalent U-factor or total UA calculation may also be used to demonstrate compliance, as follows:

An assembly with a U-factor equal or less than specified in 2009 IECC Table 402.1.3 complies.

A total building thermal envelope UA that is less than or equal to the total UA resulting from the U-factors in Table 402.1.3 also complies. The performance of all components (i.e., ceilings, walls, floors, slabs, and fenestration) can be traded off using the UA approach. Note that Items 3.1 through 3.3 of the National Rater Field Checklist shall be met regardless of the UA tradeoffs calculated. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The calculation for a steel-frame envelope assembly shall use the ASHRAE zone method or a method providing equivalent results, and not a series-parallel path calculation method.
5. Consistent with the 2009 IECC, slab edge insulation is only required for slab-on-grade floors with a floor surface less than 12 inches below grade. Slab insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using  $\geq R-3$  rigid insulation on top of an existing slab (e.g., in a home undergoing a gut rehabilitation). In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
6. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the house, slab insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the home's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: [energystar.gov/slabeledge](http://energystar.gov/slabeledge).
7. The Rater shall collect one National HVAC Design Report per system design per plan. Regardless of whether the "site-specific design" or "group design" box has been checked in Item 1.6 of the National HVAC Design Report, the system design as documented on the National HVAC Design Report must fall within the tolerances in Item 4.2 for the home to be certified. The report is only required to be collected once per system design, even if multiple homes are built using this design (e.g., in a production environment where the same plan is built multiple times, only one report is required as long as no aspect of the system design changes between homes). The Rater is only responsible for verifying that the designer has not left any items blank on the National HVAC Design Report and for verifying the discrete objective parameters in Item 4.2 of this Checklist, not for verifying the accuracy of every input on the National HVAC Design Report.



# National Rater Design Review Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

8. Visit [energystar.gov/hvacdesigntemps](http://energystar.gov/hvacdesigntemps) for the maximum cooling season design temperature and minimum heating season design temperature permitted for ENERGY STAR certified homes and the process for a designer to obtain an allowance from EPA. The same design report is permitted to be used in other counties, as long as the design temperature limits in those other counties meet or exceed the cooling and heating season temperature limits for the county selected. For example, if Fauquier County, VA, is used for the load calculations, with a 1% cooling temperature limit of 93 F, then the same report could be used in Fairfax County (which has a higher limit of 94 F) but not in Arlington County (which has a lower limit of 92 F).
9. To determine the number of occupants among all HVAC systems in the home, calculate the number of bedrooms, as defined below, and add one. The number of occupants used in loads must be within  $\pm 2$  of the home to be certified, unless Item 1.5 of the National HVAC Design Report indicates that the system is a cooling system for temporary occupant loads.

A bedroom is defined by ANSI / RESNET / ICC Standard 301-2014 as a room or space 70 sq. ft. or greater size, with egress window and closet, used or intended to be used for sleeping. A "den", "library", or "home office" with a closet, egress window, and 70 sq. ft. or greater size or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.

An egress window, as defined in 2009 IRC section R310, shall refer to any operable window that provides for a means of escape and access for rescue in the event of an emergency. The egress window definition has been summarized for convenience. The egress window shall:

  - have a sill height of not more than 44 inches above the floor; AND
  - have a minimum net clear opening of 5.7 sq. ft.; AND
  - have a minimum net clear opening height of 24 in.; AND
  - have a minimum net clear opening width of 20 in.; AND
  - be operational from the inside of the room without the use of keys, tools or special knowledge.
10. "Predominant" is defined as the SHGC value used in the greatest amount of window area in the home.
11. Orientation represents the direction that the front door of the house is facing. The designer is only required to document the loads for the orientation(s) that the house might be built in. For example, if a house plan will only be built one time in a specific orientation (e.g., a site-specific design), then the designer only needs to document the loads for this one orientation.



# National Rater Field Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

Home Address: _____		City: _____		State: _____		Permit Date: _____				
Thermal Enclosure System							Must Correct	Builder Verified <sup>1</sup>	Rater Verified <sup>2</sup>	N/A <sup>3</sup>
1. High-Performance Fenestration & Insulation										
1.1 Fenestration meets or exceeds specification in Item 2.1 of the National Rater Design Review Checklist							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
1.2 Insulation meets or exceeds specification in Item 3.1 of the National Rater Design Review Checklist							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
1.3 All insulation achieves Grade I install. per ANSI / RESNET / ICC Std. 301. Alternatives in Footnote 4. 4,5							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
2. Fully-Aligned Air Barriers <sup>6</sup> At each insulated location below, a complete air barrier is provided that is fully aligned as follows:										
Ceilings: At interior or exterior horizontal surface of ceiling insulation in Climate Zones 1-3; at interior horizontal surface of ceiling insulation in Climate Zones 4-8. Also, at exterior vertical surface of ceiling insulation in all climate zones (e.g., using a wind baffle that extends to the full height of the insulation in every bay or a tabbed baffle in each bay with a soffit vent that prevents wind washing in adjacent bays). <sup>7</sup>										
2.1 Dropped ceilings / soffits below unconditioned attics, and all other ceilings							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Walls: At exterior vertical surface of wall insulation in all climate zones; also at interior vertical surface of wall insulation in Climate Zones 4-8 <sup>8</sup>										
2.2 Walls behind showers, tubs, staircases, and fireplaces							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Attic knee walls and skylight shaft walls <sup>9</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.4 Walls adjoining porch roofs or garages							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.5 Double-walls and all other exterior walls							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. Alternatives in Footnotes 11 & 12. 10, 11, 12										
2.6 Floors above garages, floors above unconditioned basements or crawlspaces, and cantilevered floors							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.7 All other floors adjoining unconditioned space (e.g., rim / band joists at exterior wall or at porch roof)							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Reduced Thermal Bridging										
3.1 For insulated ceilings with attic space above (i.e., non-cathedralized), Grade I insulation extends to the inside face of the exterior wall below and is $\geq R-21$ in CZ 1-5; $\geq R-30$ in CZ 6-8 <sup>13</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 For slabs on grade in CZ 4-8, 100% of slab edge insulated to $\geq R-5$ at the depth specified by the 2009 IECC and aligned with the thermal boundary of the walls <sup>14, 15</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 Insulation beneath attic platforms (e.g., HVAC platforms, walkways) $\geq R-21$ in CZ 1-5; $\geq R-30$ in CZ 6-8							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4 At above-grade walls separating conditioned from unconditioned space, one of the following options used (rim / band joists exempted): <sup>16</sup>										
3.4.1 Continuous rigid insulation, insulated siding, or combination of the two is: $\geq R-3$ in CZ 1-4; $\geq R-5$ in CZ 5-8 <sup>17, 18, 19</sup> ; <b>OR</b> ;							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.2 Structural Insulated Panels <b>OR</b> ; Insulated Concrete Forms <b>OR</b> ; Double-wall framing <b>OR</b> ; <sup>17,20</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.3 Advanced framing, including all of the Items below: <sup>21</sup>										
3.4.3a Corners insulated $\geq R-6$ to edge <sup>22</sup> ; <b>AND</b> ;							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.3b Headers above windows & doors insulated $\geq R-3$ for 2x4 framing or equivalent cavity width, and $\geq R-5$ for all other assemblies (e.g., with 2x6 framing) <sup>23</sup> ; <b>AND</b> ;							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.3c Framing limited at all windows & doors to one pair of king studs, plus one pair of jack studs per window opening to support the header and sill, <b>AND</b> ;							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.3d Interior / exterior wall intersections insulated to same R-value as rest of exterior wall, <sup>24</sup> <b>AND</b> ;							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4.3e Minimum stud spacing of 16 in. o.c. for 2x4 framing in all Climate Zones and, in CZ 6-8, 24 in. o.c. for 2x6 framing <sup>25</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material)										
4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
4.2 Recessed lighting fixtures adjacent to unconditioned space ICAT labeled and gasketed. Also, if in insulated ceiling without attic above, exterior surface of fixture insulated to $\geq R-10$ in CZ 4-8.							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 Above-grade sill plates adjacent to conditioned space sealed to foundation or sub-floor. Gasket also placed beneath above-grade sill plate if resting atop concrete / masonry & adjacent to cond. space <sup>26,27</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 Continuous top plate or blocking is at top of walls adjoining unconditioned space, and sealed							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5 Drywall sealed to top plate at all unconditioned attic / wall interfaces using caulk, foam, drywall adhesive (but not other construction adhesives), or equivalent material. Either apply sealant directly between drywall and top plate or to the seam between the two from the attic above.							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.6 Rough opening around windows & exterior doors sealed <sup>28</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-
4.7 Walls that separate attached garages from occupiable space sealed and, also, an air barrier installed and sealed at floor cavities aligned with these walls							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.8 In multifamily buildings, the gap between the common wall (e.g. the drywall shaft wall) and the structural framing between units sealed at all exterior boundaries							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.9 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air-tight with weatherstripping or equivalent gasket.							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.10 Attic access panels, drop-down stairs, & whole-house fans equipped with durable $\geq R-10$ cover that is gasketed (i.e., not caulked). Fan covers either installed on house side or mechanically operated. <sup>29</sup>							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



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## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

HVAC System <sup>30</sup> (National HVAC Design Report Item # in parenthesis)				Must Correct	Rater Verified <sup>2</sup>	N/A <sup>3</sup>
<b>5. Heating &amp; Cooling Equipment</b>						
5.1 HVAC manufacturer & model number on installed equipment matches either of the following (check box): <sup>31</sup> <input type="checkbox"/> National HVAC Design Report (4.3, 4.4, & 4.17) <input type="checkbox"/> Written approval received from designer				<input type="checkbox"/>	<input type="checkbox"/>	-
5.2 External static pressure measured by Rater at contractor-provided test locations and documented below: <sup>32</sup> Return-Side External Static Pressure: _____ IWC    Supply-Side External Static Pressure: _____ IWC				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.3 <u>Permitted, but not required</u> : National HVAC Commissioning Checklist collected, with no items left blank				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>6. Duct Quality Installation - Applies to Heating, Cooling, Ventilation, Exhaust, &amp; Pressure Balancing Ducts, Unless Noted in Footnote</b>						
6.1 Ductwork installed without kinks, sharp bends, compressions, or excessive coiled flexible ductwork <sup>33</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.2 Bedrooms pressure-balanced (e.g., using transfer grilles, jump ducts, dedicated return ducts, undercut doors) to achieve a Rater-measured pressure differential $\geq -3$ Pa and $\leq +3$ Pa with respect to the main body of the house when all air handlers are operating. Test configuration and an alternative compliance option in Footnote 34. <sup>34</sup>				<input type="checkbox"/>	<input type="checkbox"/>	-
6.3 All supply and return ducts in unconditioned space, including connections to trunk ducts, are insulated to $\geq R-6$ <sup>35</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.4 Rater-measured total duct leakage meets one of the following two options. Alternative in Footnote 37: <sup>36, 37, 38</sup>						
6.4.1 <u>Rough-in</u> : The greater of $\leq 4$ CFM25 per 100 sq. ft. of CFA or $\leq 40$ CFM25, with air handler & all ducts, building cavities used as ducts, & duct boots installed. In addition, <u>all</u> duct boots sealed to finished surface, Rater-verified at final. <sup>39</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.4.2 <u>Final</u> : The greater of $\leq 8$ CFM25 per 100 sq. ft. of CFA or $\leq 80$ CFM25, with the air handler & all ducts, bldg. cavities used as ducts, duct boots, & register grilles atop the finished surface (e.g., drywall, floor) installed <sup>40</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.5 Rater-measured duct leakage to outdoors the greater of $\leq 4$ CFM25 per 100 sq. ft. of CFA or $\leq 40$ CFM25 <sup>36, 38, 41</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>7. Whole-House Mechanical Ventilation System</b>						
7.1 Rater-measured ventilation rate is within either $\pm 15$ CFM or $\pm 15\%$ of design value (2.3) <sup>42</sup>				<input type="checkbox"/>	<input type="checkbox"/>	-
7.2 A readily-accessible ventilation override control installed and also labeled if its function is not obvious (e.g., a label is required for a standalone wall switch, but not for a switch that's on the ventilation equipment) <sup>43</sup>				<input type="checkbox"/>	<input type="checkbox"/>	-
7.3 No outdoor air intakes connected to return side of the HVAC system, unless controls are installed to operate intermittently & automatically based on a timer and to restrict intake when not in use (e.g., motorized damper)				<input type="checkbox"/>	<input type="checkbox"/>	-
7.4 System fan rated $\leq 3$ sones if intermittent and $\leq 1$ sone if continuous, or exempted <sup>44</sup>				<input type="checkbox"/>	<input type="checkbox"/>	-
7.5 If system utilizes the HVAC fan, then the specified fan type is ECM / ICM (4.7), or the controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.6 Bathroom fans are ENERGY STAR certified if used as part of the whole-house system <sup>45</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.7 Air inlet location (Complete if ventilation air inlet location was specified (2.12, 2.13); otherwise check "N/A"): <sup>46, 47</sup>				-	-	<input type="checkbox"/>
7.7.1 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit				<input type="checkbox"/>	<input type="checkbox"/>	-
7.7.2 Inlet is $\geq 2$ ft. above grade or roof deck; $\geq 10$ ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and $\geq 3$ ft. distance from dryer exhausts and sources exiting the roof				<input type="checkbox"/>	<input type="checkbox"/>	-
7.7.3 Inlet is provided with rodent / insect screen with $\leq 0.5$ inch mesh				<input type="checkbox"/>	<input type="checkbox"/>	-
<b>8. Local Mechanical Exhaust - In each kitchen and bathroom, a system is installed that exhausts directly to the outdoors and meets one of the following Rater-measured airflow and manufacturer-rated sound level standards: <sup>42, 48</sup></b>						
<b>Location</b>		<b>Continuous Rate</b>		<b>Intermittent Rate <sup>49</sup></b>		
8.1 Kitchen	Airflow	$\geq 5$ ACH, based on kitchen volume <sup>50, 51</sup>		$\geq 100$ CFM and, if not integrated with range, also $\geq 5$ ACH based on kitchen volume <sup>50, 51, 52</sup>		
	Sound	Recommended: $\leq 1$ sone		Recommended: $\leq 3$ sones		
8.2 Bathroom	Airflow	$\geq 20$ CFM		$\geq 50$ CFM		
	Sound	Required: $\leq 1$ sone		Recommended: $\leq 3$ sones		
<b>9. Filtration</b>						
9.1 At least one MERV 6 or higher filter installed in each ducted mechanical system in a location that facilitates access and regular service by the occupant <sup>53</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.2 Filter access panel includes gasket or comparable sealing mechanism and fits snugly against the exposed edge of filter when closed to prevent bypass <sup>54</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.3 All return air and mechanically supplied outdoor air passes through filter prior to conditioning				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>10. Combustion Appliances</b>						
10.1 Furnaces, boilers, and water heaters located within the home's pressure boundary are mechanically drafted or direct-vented. Alternatives in Footnote 57. <sup>55, 56, 57</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.2 Fireplaces located within the home's pressure boundary are mechanically drafted or direct-vented. Alternatives in Footnote 59. <sup>55, 56, 58</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10.3 If unvented combustion appliances other than cooking ranges or ovens are located inside the home's pressure boundary, the Rater has followed Section 802 of RESNET's Standards, encompassing ANSI/ACCA 12 QH-2014, Appendix A, Section A3 (Carbon Monoxide Test), and verified the equipment meets the limits defined within <sup>55, 59</sup>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rater Name: _____		Rater Pre-Drywall Inspection Date: _____		Rater Initials: _____		
Rater Name: _____		Rater Final Inspection Date: _____		Rater Initials: _____		
Builder Employee: _____		Builder Inspection Date: _____		Builder Initials: _____		



# National Rater Field Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### Footnotes

1. At the discretion of the Rater, the builder may verify up to eight items in Sections 1-4 of this Checklist. When exercised, the builder's responsibility will be formally acknowledged by the builder signing off on the checklist for the item(s) that they verified. However, if a quality assurance review indicates that Items have not been successfully completed, the Rater will be responsible for facilitating corrective action.
2. The term 'Rater' refers to the person completing the third-party inspections required for certification. This person shall: a) be a certified Home Energy Rater, Rating Field Inspector, or an equivalent designation as determined by a Verification Oversight Organization such as RESNET; and, b) have attended and successfully completed an EPA-recognized training class. See [energystar.gov/newhomestraining](http://energystar.gov/newhomestraining).
3. The column titled "N/A," which denotes items that are "not applicable," should be used when the checklist Item is not present in the home or conflicts with local requirements.
4. Two alternatives are provided: a) Grade II cavity insulation is permitted to be used for assemblies that contain a layer of continuous, air impermeable insulation  $\geq R-3$  in Climate Zones 1 to 4,  $\geq R-5$  in Climate Zones 5 to 8; b) Grade II batts are permitted to be used in floors if they fill the full depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving Grade I is the compression caused by the excess insulation.
5. Ensure compliance with this requirement using the version of ANSI / RESNET / ICC Std. 301 utilized by RESNET for HERS ratings.
6. For purposes of this Checklist, an air barrier is defined as any durable solid material that blocks air flow between conditioned space and unconditioned space, including necessary sealing to block excessive air flow at edges and seams and adequate support to resist positive and negative pressures without displacement or damage. EPA recommends, but does not require, rigid air barriers.  
Open-cell or closed-cell foam shall have a finished thickness  $\geq 5.5$  in. or 1.5 in., respectively, to qualify as an air barrier unless the manufacturer indicates otherwise.  
If flexible air barriers such as house wrap are used, they shall be fully sealed at all seams and edges and supported using fasteners with caps or heads  $\geq 1$  in. diameter unless otherwise indicated by the manufacturer. Flexible air barriers shall not be made of kraft paper, paper-based products, or other materials that are easily torn. If polyethylene is used, its thickness shall be  $\geq 6$  mil.
7. All insulated ceiling surfaces, regardless of slope (e.g., cathedral ceilings, tray ceilings, conditioned attic roof decks, flat ceilings, sloped ceilings), must meet the requirements for ceilings.
8. All insulated vertical surfaces are considered walls (e.g., above and below grade exterior walls, knee walls) and must meet the air barrier requirements for walls. The following exceptions apply: air barriers recommended, but not required, in adiabatic walls in multifamily dwellings; and, in Climate Zones 4 through 8, an air barrier at the interior vertical surface of insulation is recommended but not required in basement walls or crawlspace walls. For the purpose of these exceptions, a basement or crawlspace is a space for which  $\geq 40\%$  of the total gross wall area is below-grade.
9. Exterior air barriers are not required for attic knee walls that are  $\leq 24$  in. in height if an interior air barrier is provided and insulation extends in all directions from the top of this interior air barrier into unconditioned space at the following levels: CZ 1-5:  $\geq R-21$ ; CZ 6-8:  $\geq R-30$ .
10. EPA highly recommends, but does not require, an air barrier at the interior vertical surface of floor insulation in Climate Zones 4-8.
11. Examples of supports necessary for permanent contact include staves for batt insulation or netting for blown-in insulation. Alternatively, supports are not required if batts fill the full depth of the floor cavity, even when compression occurs due to excess insulation, as long as the R-value of the batts has been appropriately assessed based on manufacturer guidance and the only defect preventing the insulation from achieving the required installation grade is the compression caused by the excess insulation.
12. Alternatively, an air barrier is permitted to be installed at the exterior horizontal surface of the floor insulation if the insulation is installed in contact with this air barrier, the exterior vertical surfaces of the floor cavity are also insulated, and air barriers are included at the exterior vertical surfaces of this insulation.
13. The minimum designated R-values must be achieved regardless of the trade-offs determined using an equivalent U-factor or UA alternative calculation, with the following exception:  
For homes permitted through 12/31/2012: CZ 1-5: For spaces that provide less than 5.5 in. of clearance, R-15 Grade I insulation is permitted. CZ 6-8: For spaces that provide less than 7.0 in. of clearance, R-21 Grade I insulation is permitted.  
For homes permitted on or after 01/01/2013: Homes shall achieve Item 3.1 without exception.  
Note that if the minimum designated values are used, then higher insulation values may be needed elsewhere to meet Item 1.2. Also, note that these requirements can be met by using any available strategy, such as a raised-heel truss, alternate framing that provides adequate space, and / or high-density insulation.
14. Consistent with the 2009 IECC, slab edge insulation is only required for slab-on-grade floors with a floor surface less than 12 inches below grade. Slab insulation shall extend to the top of the slab to provide a complete thermal break. If the top edge of the insulation is installed between the exterior wall and the edge of the interior slab, it shall be permitted to be cut at a 45-degree angle away from the exterior wall. Alternatively, the thermal break is permitted to be created using  $\geq R-3$  rigid insulation on top of an existing slab (e.g., in a home undergoing a gut rehabilitation). In such cases, up to 10% of the slab surface is permitted to not be insulated (e.g., for sleepers, for sill plates). Insulation installed on top of slab shall be covered by a durable floor surface (e.g., hardwood, tile, carpet).
15. Where an insulated wall separates a garage, patio, porch, or other unconditioned space from the conditioned space of the house, slab insulation shall also be installed at this interface to provide a thermal break between the conditioned and unconditioned slab. Where specific details cannot meet this requirement, partners shall provide the detail to EPA to request an exemption prior to the home's certification. EPA will compile exempted details and work with industry to develop feasible details for use in future revisions to the program. A list of currently exempted details is available at: [energystar.gov/slabeledge](http://energystar.gov/slabeledge).
16. Mass walls utilized as the thermal mass component of a passive solar design (e.g., a Trombe wall) are exempt from this Item. To be eligible for this exemption, the passive solar design shall be comprised of the following five components: an aperture or collector, an absorber, thermal mass, a distribution system, and a control system. For more information, see: [energy.gov/sites/prod/files/guide\\_to\\_passive\\_solar\\_home\\_design.pdf](http://energy.gov/sites/prod/files/guide_to_passive_solar_home_design.pdf).



# National Rater Field Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

Mass walls that are not part of a passive solar design (e.g., CMU block or log home enclosure) shall either utilize the strategies outlined in Item 3.4 or the pathway in the assembly with the least thermal resistance, as determined using a method consistent with the 2013 ASHRAE Handbook of Fundamentals, shall provide  $\geq 50\%$  of the applicable assembly resistance, defined as the reciprocal of the mass wall equivalent U-factor in the 2009 IECC Table 402.1.3. Documentation identifying the pathway with the least thermal resistance and its resistance value shall be collected by the Rater and any Builder Verified or Rater Verified box under Item 3.4 shall be checked.

17. Up to 10% of the total exterior wall surface area is exempted from the reduced thermal bridging requirements to accommodate intentional designed details (e.g., architectural details such as thermal fins, wing walls, or masonry fireplaces; structural details, such as steel columns). It shall be apparent to the Rater that the exempted areas are intentional designed details or the exempted area shall be documented in a plan provided by the builder, architect, or engineer. The Rater need not evaluate the necessity of the designed detail to certify the home.
18. If used, insulated siding shall be attached directly over a water-resistive barrier and sheathing. In addition, it shall provide the required R-value as demonstrated through either testing in accordance with ASTM C 1363 or by attaining the required R-value at its minimum thickness. Insulated sheathing rated for water protection can be used as a water resistant barrier if all seams are taped and sealed. If non-insulated structural sheathing is used at corners, the advanced framing details listed in Item 3.4.3 shall be met for those wall sections.
19. Steel framing shall meet the reduced thermal bridging requirements by complying with Item 3.4.1 of the Checklist.
20. Double-wall framing is defined as any framing method that ensures a continuous layer of insulation covering the studs to at least the R-value required in Item 3.4.1 of the Checklist, such as offset double-stud walls, aligned double-stud walls with continuous insulation between the adjacent stud faces, or single-stud walls with 2x2 or 2x3 cross-framing. In all cases, insulation shall fill the entire wall cavity from the interior to exterior sheathing except at windows, doors and other penetrations.
21. All advanced framing details shall be met except where the builder, architect, or engineer provides a framing plan that encompasses the details in question, indicating that structural members are required at these locations and including the rationale for these members (e.g., full-depth solid framing is required at wall corners or interior / exterior wall intersections for shear strength, a full-depth solid header is required above a window to transfer load to jacks studs, additional jack studs are required to support transferred loads, additional cripple studs are required to maintain on-center spacing, or stud spacing must be reduced to support multiple stories in a multifamily building). The Rater shall retain a copy of the detail and rationale for their records, but need not evaluate the rationale to certify the home.
22. All exterior corners shall be constructed to allow access for the installation of  $\geq R-6$  insulation that extends to the exterior wall sheathing. Examples of compliance options include standard-density insulation with alternative framing techniques, such as using three studs per corner, or high-density insulation (e.g., spray foam) with standard framing techniques.
23. Compliance options include continuous rigid insulation sheathing, SIP headers, other prefabricated insulated headers, single-member or two-member headers with insulation either in between or on one side, or an equivalent assembly. R-value requirement refers to manufacturer's nominal insulation value.
24. Insulation shall run behind interior / exterior wall intersections using ladder blocking, full length 2x6 or 1x6 furring behind the first partition stud, drywall clips, or other equivalent alternative.
25. In Climate Zones 6 - 8, a minimum stud spacing of 16 in. o.c. is permitted to be used with 2x6 framing if  $\geq R-20.0$  wall cavity insulation is achieved. However, all 2x6 framing with stud spacing of 16 in. o.c. in Climate Zones 6 - 8 shall have  $\geq R-20.0$  wall cavity insulation installed regardless of any framing plan or alternative equivalent total UA calculation.
26. Existing sill plates (e.g., in a home undergoing a gut rehabilitation) on the interior side of structural masonry or monolithic walls are exempt from this Item. In addition, other existing sill plates resting atop concrete or masonry and adjacent to conditioned space are permitted, in lieu of using a gasket, to be sealed with caulk, foam, or equivalent material at both the interior seam between the sill plate and the subfloor and the seam between the top of the sill plate and the sheathing.
27. In Climate Zones 1 through 3, a continuous stucco cladding system adjacent to sill and bottom plates is permitted to be used in lieu of sealing plates to foundation or sub-floor with caulk, foam, or equivalent material.
28. In Climate Zones 1 through 3, a continuous stucco cladding system sealed to windows and doors is permitted to be used in lieu of sealing rough openings with caulk or foam.
29. Examples of durable covers include, but are not limited to, pre-fabricated covers with integral insulation, rigid foam adhered to cover with adhesive, or batt insulation mechanically fastened to the cover (e.g., using bolts, metal wire, or metal strapping).
30. This Checklist is designed to meet the requirements of ASHRAE 62.2-2010 / 2013 / 2016, and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new homes when compared to homes built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems, (e.g., those caused by a lack of maintenance by occupants). Therefore, this Checklist is not a guarantee of proper ventilation, indoor air quality, or HVAC performance.
31. If installed equipment does not match the National HVAC Design Report, then prior to certification the Rater shall obtain written approval from the designer (e.g., email, updated National HVAC Design Report) confirming that the installed equipment meets the requirements of the National HVAC Design Report. In cases where the condenser unit is installed after the time of inspection by the Rater, the HVAC manufacturer and model numbers on installed equipment can be documented through the use of photographs provided by the HVAC Contractor after installation is complete.
32. The Rater shall measure and record the external static pressure in the return-side and supply-side of the system using the contractor-provided test locations. However, at this time, the Rater need not assess whether these values are within a specific range to certify the home.
33. Kinks are to be avoided and are caused when ducts are bent across sharp corners such as framing members. Sharp bends are to be avoided and occur when the radius of the turn in the duct is less than one duct diameter. Compression is to be avoided and occurs when flexible ducts in unconditioned space are installed in cavities smaller than the outer duct diameter and ducts in conditioned space are installed in cavities smaller than inner duct diameter. Ducts shall not include coils or loops except to the extent needed for acoustical control.
34. Item 6.2 does not apply to ventilation or exhaust ducts. For an HVAC system with a multi-speed fan, the highest design fan speed shall be used when verifying this requirement. When verifying this requirement, doors separating bedrooms from the main body of the house (e.g., a door between a bedroom and a hallway) shall be closed and doors to rooms that can only be entered from the bedroom (e.g., a closet, a bathroom) shall be open. As an alternative to the  $\pm 3$  Pa limit, a Rater-measured pressure differential  $\geq -5$  Pa and  $\leq +5$  Pa is permitted to be used for bedrooms with a design airflow  $\geq 150$  CFM. The Rater-measured pressure shall be rounded to the nearest whole number to assess compliance





# National Rater Field Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

35. Item 6.3 does not apply to ducts that are a part of local mechanical exhaust and exhaust-only whole-house ventilation systems. EPA recommends, but does not require, that all metal ductwork not encompassed by Section 6 (e.g., exhaust ducts, duct boots, ducts in conditioned space) also be insulated and that insulation be sealed to duct boots to prevent condensation.
36. Items 6.4 and 6.5 only apply to heating, cooling, and balanced ventilation ducts. Duct leakage shall be determined and documented by a Rater using the same version of ANSI / RESNET / ICC Std. 380 that is utilized by RESNET for HERS ratings. Leakage limits shall be assessed on a per-system, rather than per-home, basis. For balanced ventilation ducts that are not connected to space heating or cooling systems, a Rater is permitted to visually verify, in lieu of duct leakage testing, that all seams and connections are sealed with mastic or metal tape and all duct boots are sealed to floor, wall, or ceiling using caulk, foam, or mastic tape.
37. For a duct system with three or more returns, the total Rater-measured duct leakage is permitted to be the greater of  $\leq 6$  CFM25 per 100 sq. ft. of CFA or  $\leq 60$  CFM25 at 'rough-in' or the greater of  $\leq 12$  CFM25 per 100 sq. ft. of CFA or  $\leq 120$  CFM25 at 'final'.
38. For a home certified in the State of ID, MT, OR, or WA that is permitted before 01/01/2016, as an alternate to Rater-verified duct leakage, a PTCS<sup>®</sup> Duct Sealing Certification Form is permitted to be collected by the Home Energy Rater.
39. Cabinets (e.g., kitchen, bath, multimedia) or ducts that connect duct boots to toe-kick registers are not required to be in place during the 'rough-in' test. For homes permitted through 12/31/2013: Homes are permitted to be certified if rough-in leakage is  $\leq 6$  CFM25 per 100 sq. ft. of CFA or  $\leq 60$  CFM25, with air handler & all ducts, building cavities used as ductwork, & duct boots installed.
40. Registers atop carpets are permitted to be removed and the face of the duct boot temporarily sealed during testing. In such cases, the Rater shall visually verify that the boot has been durably sealed to the subfloor (e.g., using duct mastic or caulk) to prevent leakage during normal operation.
41. Testing of duct leakage to the outside can be waived if all ducts & air handling equipment are located within the home's air and thermal barriers AND infiltration does not exceed the following: CZ 1-2: 3 ACH50; CZ 3-4: 2.5 ACH50; CZ 5-7: 2 ACH50; CZ 8: 1.5 ACH50. Alternatively, testing of duct leakage to the outside can be waived if total duct leakage is  $\leq 4$  CFM25 per 100 sq. ft. of conditioned floor area or 40 CFM25, whichever is larger.
42. The whole-house ventilation air flow and local exhaust air flows shall be determined and documented by a Rater using the same version of ANSI / RESNET / ICC Std. 380 that is utilized by RESNET for HERS ratings.
43. In a multi-family dwelling unit, the override control is not required to be readily accessible to the occupant. However, in such cases, EPA recommends but does not require that the control be readily accessible to others (e.g., building maintenance staff) in lieu of the occupant.
44. Whole-house mechanical ventilation fans shall be rated for sound at no less than the airflow rate in Item 2.3 of the National HVAC Design Report. Fans exempted from this requirement include HVAC air handler fans, remote-mounted fans, and intermittent fans rated  $\geq 400$  CFM. To be considered for this exemption, a remote-mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways and there shall be  $\geq 4$  ft. ductwork between the fan and intake grill. Per ASHRAE 62.2-2010, habitable spaces are intended for continual human occupancy; such space generally includes areas used for living, sleeping, dining, and cooking but does not generally include bathrooms, toilets, hallways, storage areas, closets, or utility rooms.
45. Bathroom fans with a rated flow rate  $\geq 500$  CFM are exempted from the requirement to be ENERGY STAR certified.
46. Ventilation air inlets that are only visible via rooftop access are exempted from Item 7.7 and the Rater shall mark "n/a". The outlet and inlet of balanced ventilation systems shall meet these spacing requirements unless manufacturer instructions indicate that a smaller distance may be used. However, if this occurs the manufacturer's instructions shall be collected for documentation purposes.
47. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the occupant.
48. Continuous bathroom local mechanical exhaust fans shall be rated for sound at no less than the airflow rate in Item 8.2. Intermittent bathroom and both intermittent and continuous kitchen local mechanical exhaust fans are recommended, but not required, to be rated for sound at no less than the airflow rate in Items 8.1 and 8.2. Per ASHRAE 62.2-2010, an exhaust system is one or more fans that remove air from the building, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope (e.g., bath exhaust fans, range hoods, clothes dryers). Per ASHRAE 62.2-2010, a bathroom is any room containing a bathtub, shower, spa, or similar source of moisture.
49. An intermittent mechanical exhaust system, where provided, shall be designed to operate as needed by the occupant. Control devices shall not impede occupant control in intermittent systems.
50. Kitchen volume shall be determined by drawing the smallest possible rectangle on the floor plan that encompasses all cabinets, pantries, islands, peninsulas, ranges / ovens, and the kitchen exhaust fan, and multiplying by the average ceiling height for this area. In addition, the continuous kitchen exhaust rate shall be  $\geq 25$  CFM, per 2009 IRC Table M1507.3, regardless of the rate calculated using the kitchen volume. Cabinet volume shall be included in the kitchen volume.
51. For homes permitted through 01/01/2014: Homes are permitted to be certified without enforcement of this Item to provide partners with additional time to integrate this feature into their homes.  
For homes permitted on or after 01/01/2014: Homes shall meet this Item. Alternatively, the prescriptive duct sizing requirements in Table 5.3 of ASHRAE 62.2-2010 / 2013 / 2016 are permitted to be used for kitchen exhaust fans based upon the rated airflow of the fan at 0.25 IWC. If the rated airflow is unknown,  $\geq 6$  in. smooth duct shall be used, with a rectangular to round duct transition as needed. Guidance to assist partners with these alternatives is available at [energystar.gov/newhomesresources](http://energystar.gov/newhomesresources). As an alternative to Item 8.1, homes are permitted to use a continuous kitchen exhaust rate of 25 CFM per 2009 IRC Table M1507.3, if they are either a) PHIUS+ or PHI certified, or b) provide both whole-house ventilation and local mechanical kitchen exhaust using a balanced system, and have a Rater-verified whole-building infiltration rate  $\leq 0.05$  CFM50 per sq. ft. of Enclosure Area, and a Rater-verified dwelling unit compartmentalization rate  $\leq 0.30$  CFM50 per sq. ft. of Enclosure Area if multiple dwelling units are present in the building. 'Enclosure Area' is defined as the area of the surfaces that bound the volume being pressurized / depressurized during the test.
52. All intermittent kitchen exhaust fans must be capable of exhausting at least 100 CFM. In addition, if the fan is not part of a vented range hood or appliance-range hood combination (i.e., if the fan is not integrated with the range), then it must also be capable of exhausting  $\geq 5$  ACH, based on the kitchen volume.



# National Rater Field Checklist

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

53. Based upon ASHRAE 62.2-2010, ducted mechanical systems are those that supply air to an occupiable space with a total amount of supply ductwork exceeding 10 ft. in length and through a thermal conditioning component, except for evaporative coolers. Systems that do not meet this definition are exempt from this requirement. While filters are recommended for mini-split systems, HRV's and ERV's, these systems, ducted or not, typically do not have MERV-rated filters available for use and are, therefore, also exempted under this version of the requirements. HVAC filters located in the attic shall be considered accessible to the occupant if either 1) drop-down stairs provide access to attic and a permanently installed walkway has been provided between the attic access location and the filter or 2) the filter location enables arm-length access from a portable ladder without the need to step into the attic and the ceiling height where access is provided is  $\leq 12$  ft.
54. The filter media box (i.e., the component in the HVAC system that houses the filter) may be either site-fabricated by the installer or pre-fabricated by the manufacturer to meet this requirement. These requirements only apply when the filter is installed in a filter media box located in the HVAC system, not when the filter is installed flush with the return grill.
55. The pressure boundary is the primary enclosure boundary separating indoor and outdoor air. For example, a volume that has more leakage to outside than to conditioned space would be outside the pressure boundary.
56. Per the 2009 International Mechanical Code, a direct-vent appliance is one that is constructed and installed so that all air for combustion is derived from the outdoor atmosphere and all flue gases are discharged to the outside atmosphere; a mechanical draft system is a venting system designed to remove flue or vent gases by mechanical means consisting of an induced draft portion under non-positive static pressure or a forced draft portion under positive static pressure; and a natural draft system is a venting system designed to remove flue or vent gases under nonpositive static vent pressure entirely by natural draft.
57. Naturally drafted equipment is allowed within the home's pressure boundary in Climate Zones 1-3 if the Rater has followed Section 802 of RESNET's Standards, encompassing ANSI / ACCA 12 QH-2014, Appendix A, Sections A3 (Carbon Monoxide Test) and A4 (Depressurization Test for the Combustion Appliance Zone), and verified that the equipment meets the limits defined within.
58. Naturally drafted fireplaces are allowed within the home's pressure boundary if the Rater has verified that the total net rated exhaust flow of the two largest exhaust fans (excluding summer cooling fans) is  $\leq 15$  CFM per 100 sq. ft. of occupiable space when at full capacity. If the net exhaust flow exceeds the allowable limit, it shall be reduced or compensating outdoor airflow provided. Per ASHRAE 62.2-2010, the term "net rated exhaust flow" is defined as flow through an exhaust fan minus the compensating outdoor airflow through any supply fan that is interlocked to the exhaust fan. Per ASHRAE 62.2-2010, the term "occupiable space" is defined as any enclosed space inside the pressure boundary and intended for human activities, including, but not limited to, all habitable spaces, toilets, closets, halls, storage and utility areas, and laundry areas. See Footnote 44 for the definition of "habitable spaces".
59. The minimum volume of combustion air required for safe operation by the manufacturer and / or code shall be met or exceeded. Also, in accordance with the National Fuel Gas Code, ANSI Z223.1 / NFPA54, unvented room heaters shall not be installed in bathrooms or bedrooms.



# National HVAC Design Report <sup>1</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### HVAC Designer Responsibilities:

- Complete one National HVAC Design Report for each system design for a house plan, created for either the specific plan configuration (i.e., elevation, option, orientation, & county) of the home to be certified or for a plan that is intended to be built with different configurations (i.e., different elevations, options, and/or orientations). Visit [www.energystar.gov/newhomeshvacdesign](http://www.energystar.gov/newhomeshvacdesign) and see Footnote 2 for more information. <sup>2</sup>
- Obtain efficiency features (e.g., window performance, insulation levels, and infiltration rate) from the builder or Home Energy Rater.
- Provide the completed National HVAC Design Report to the builder or credentialed HVAC contractor and to the Home Energy Rater.

### 1. Design Overview

1.1 Designer name: \_\_\_\_\_ Designer company: \_\_\_\_\_ Date: \_\_\_\_\_

1.2 Select which party you are providing these design services to:  Builder or  Credentialed HVAC contractor

1.3 Name of company you are providing these design services to (if different than Item 1.1): \_\_\_\_\_

1.4 Area that system serves:  Whole-house  Upper-level  Lower-level  Other \_\_\_\_\_

1.5 Is cooling system for a temporary occupant load? <sup>3</sup>  Yes  No

1.6 House plan: \_\_\_\_\_ Check box to indicate whether the system design is site-specific or part of a group: <sup>2</sup>

Site-specific design. Option(s) & elevation(s) modeled: \_\_\_\_\_

Group design. Group #: \_\_\_\_\_ out of \_\_\_\_\_ total groups for this house plan. Configuration modeled: \_\_\_\_\_

### 2. Whole-House Mechanical Ventilation Design <sup>4, 5</sup>

**Designer Verified**

**Airflow:**

2.1 Ventilation airflow design rate & run-time meet the requirements of ASHRAE 62.2-2010, 2013, or 2016 <sup>6</sup>

2.2 Ventilation airflow rate required by 62.2 for a continuous system \_\_\_\_\_ CFM -

2.3 Design for this system: Vent. airflow rate: \_\_\_\_\_ CFM Run-time per cycle: \_\_\_\_\_ minutes Cycle time: \_\_\_\_\_ minutes -

**System Type & Controls:**

2.4 Specified system type:  Supply  Exhaust  Balanced -

2.5 Specified control location: \_\_\_\_\_ (e.g., Master bath, utility room) -

2.6 Specified controls allow the system to operate automatically, without occupant intervention

2.7 Specified controls include a readily-accessible ventilation override and a label has also been specified if its function is not obvious (e.g., a label is required for a standalone wall switch, but not for a switch that's on the ventilation equipment)

2.8 No outdoor air intakes designed to connect to the return side of the HVAC system, unless specified controls operate intermittently and automatically based on a timer and restrict intake when not in use (e.g., motorized damper) <sup>7</sup>

**Sound:** 2.9 The fan of the specified system is rated ≤ 3 sones if intermittent and ≤ 1 sone if continuous, or exempted <sup>8</sup>

**Efficiency:**

2.10 If system utilizes the HVAC fan, then the specified fan type in Item 4.7 is ECM / ICM, or the specified controls will reduce the standalone ventilation run-time by accounting for hours when the HVAC system is heating or cooling

2.11 If bathroom fans are specified as part of the system, then they are ENERGY STAR certified <sup>9</sup>

**Air Inlet Location:** (Complete this section if system has a specified air inlet location; otherwise check "N/A") <sup>10</sup>  N/A

2.12 Inlet pulls ventilation air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit

2.13 Inlet is ≥ 2 ft. above grade or roof deck; ≥ 10 ft. of stretched-string distance from known contamination sources (e.g., stack, vent, exhaust, vehicles) not exiting the roof, and ≥ 3 ft. from known sources exiting the roof

### 3. Room-by-Room Heating & Cooling Loads

3.1 Room-by-room loads calculated using:  Unabridged ACCA Manual J v8  2013 ASHRAE Fundamentals  Other per AHJ <sup>11</sup> -

3.2 Indoor design temperatures used in loads are 70°F for heating and 75°F for cooling

3.3 Outdoor design temperatures used in loads: (See Footnote 12 and [energystar.gov/hvacdesignemps](http://energystar.gov/hvacdesignemps)) <sup>12</sup> -

County & State, or US Territory, selected: \_\_\_\_\_ Cooling season: \_\_\_\_\_ °F Heating season: \_\_\_\_\_ °F

3.4 Number of occupants used in loads: <sup>13</sup> \_\_\_\_\_ -

3.5 Conditioned floor area used in loads: \_\_\_\_\_ Sq. Ft. -

3.6 Window area used in loads: \_\_\_\_\_ Sq. Ft. -

3.7 Predominant window SHGC used in loads: <sup>14</sup> \_\_\_\_\_ -

3.8 Infiltration rate used in loads: <sup>15</sup> Summer: \_\_\_\_\_ Winter: \_\_\_\_\_ -

3.9 Mechanical ventilation rate used in loads: \_\_\_\_\_ CFM -

Loads At Design Conditions (kBtuh)		N	NE	E	SE	S	SW	W	NW	-
Cooling	3.10 Sensible heat gain (By orientation <sup>16</sup> )									-
	3.11 Latent heat gain (Not by orientation)									-
	3.12 Total heat gain (By orientation <sup>16</sup> )									-
	3.13 Maximum – minimum total heat gain (Item 3.12) across orientations = _____ kBtuh Variation is ≤ 6 kBtuh <sup>16, 17</sup>									
Heating	3.14 Total heat loss (Not by orientation)									-



# National HVAC Design Report <sup>1</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

4. Heating & Cooling Equipment Selection				Designer Verified	
4.1 Equipment selected per ACCA Manual S (see Footnote 18 & 19) <sup>18, 19</sup>				<input type="checkbox"/>	
<b>Air Conditioner / Heat Pump</b> (Complete if air conditioner or heat pump will be installed; otherwise check "N/A")				<input type="checkbox"/> N/A	
4.2 Equipment type: <input type="checkbox"/> Cooling-only air conditioner or <input type="checkbox"/> Cooling & heating heat pump				-	
4.3 Condenser manufacturer & model: _____				-	
4.4 Evaporator / fan coil manufacturer & model: _____				-	
4.5 AHRI reference #: <sup>20</sup> _____				-	
4.6 AHRI listed efficiency: _____ / _____ EER / SEER Air-source heat pump: _____ HSPF Ground-source heat pump: _____ COP				-	
4.7 Evaporator fan type: <input type="checkbox"/> PSC <input type="checkbox"/> ECM / ICM <input type="checkbox"/> Other: _____				-	
4.8 Compressor type: <input type="checkbox"/> Single-speed <input type="checkbox"/> Two-speed <input type="checkbox"/> Variable-speed				-	
4.9 Latent capacity at design conditions, from OEM expanded performance data: _____ kBtuh				-	
4.10 Sensible capacity at design conditions, from OEM expanded performance data: _____ kBtuh				-	
4.11 Total capacity at design conditions, from OEM expanded performance data: _____ kBtuh				-	
4.12 Air-source heat pump capacity: At 17°F: _____ kBtuh At 47°F: _____ kBtuh <input type="checkbox"/> N/A				-	
4.13 Cooling sizing % = Total capacity (Item 4.11) divided by maximum total heat gain (Item 3.12): _____ %				-	
4.14 Complete this Item if Condition B Climate will be used to select sizing limit in Item 4.15. Otherwise, check "N/A": <sup>21</sup> <input type="checkbox"/> N/A				-	
4.14.1 Load sensible heat ratio = Max. sensible heat gain (Item 3.10) / Max. total heat gain (Item 3.12) = _____ %				-	
4.14.2 HDD / CDD ratio (Visit <a href="http://energystar.gov/hvacdesigntemps">energystar.gov/hvacdesigntemps</a> to determine this value for the design location) = _____				-	
4.15 Check box of applicable cooling sizing limit from chart below: <sup>18, 19</sup>				-	
Equipment Type (Per Item 4.2) & Climate Condition (Per Item 4.14)	Compressor Type (Per Item 4.8)				
	Single-Speed	Two-Speed	Variable-Speed		
	<input type="checkbox"/> Recommended: 90 – 115% Allowed: 90 – 130%	<input type="checkbox"/> Recommended: 90 – 120% Allowed: 90 – 140%	<input type="checkbox"/> Recommended: 90 – 130% Allowed: 90 – 160%		
For Cooling-Only Equipment or For Cooling Mode of Heat Pump in Condition A Climate	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh		
For Cooling Mode of Heat Pump in Condition B Climate	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh	<input type="checkbox"/> 90% - 100%, plus 15 kBtuh		
4.16 Cooling sizing % (4.13) is within cooling sizing limit (4.15)				<input type="checkbox"/>	
<b>Furnace</b> (Complete if furnace will be installed; otherwise check "N/A")				<input type="checkbox"/> N/A	
4.17 Furnace manufacturer & model: _____				-	
4.18 Listed efficiency: _____ AFUE				-	
4.19 Total capacity: _____ kBtuh				-	
4.20 Heating sizing % = Total capacity (Item 4.19) divided by total heat loss (Item 3.14): _____ %				-	
4.21 Check box of applicable heating sizing limit from chart below:				-	
When Used for Heating Only		When Paired With Cooling			
<input type="checkbox"/> 100 – 140%		<input type="checkbox"/> Recommended: 100 – 140% Allowed: 100 – 400%			
4.22 Heating sizing % (4.20) is within heating sizing limit (4.21)				<input type="checkbox"/>	
<b>5. Duct Design</b> (Complete if heating or cooling equipment will be installed with ducts; otherwise check "N/A")				<input type="checkbox"/> N/A	
5.1 Duct system designed for the equipment selected in Section 4, per ACCA Manual D				<input type="checkbox"/>	
5.2 Design HVAC fan airflow: <sup>22</sup>		Cooling mode _____ CFM	Heating mode _____ CFM	-	
5.3 Design HVAC fan speed setting (e.g., low, medium, high): <sup>23</sup>		Cooling mode _____	Heating mode _____	-	
5.4 Design total external static pressure (corresponding to the mode with the higher airflow in Item 5.2): <sup>24</sup> _____ IWC				-	
5.5 Room-by-room design airflows documented below (which must sum to the mode with the higher airflow in Item 5.2) <sup>25, 26</sup>				-	
Room Name	Design Airflow (CFM)	Room Name	Design Airflow (CFM)	Room Name	Design Airflow (CFM)
1		12		23	
2		13		24	
3		14		25	
4		15		26	
5		16		27	
6		17		28	
7		18		29	
8		19		30	
9		20		31	
10		21		32	
11		22		Total for all rooms	



# National HVAC Design Report <sup>1</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### Footnotes

1. This report is designed to meet ASHRAE 62.2-2010 / 2013 / 2016 and ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new homes when compared to homes built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems (e.g., those caused by a lack of maintenance or occupant behavior). Therefore, system designs documented through the use of this report are not a guarantee of proper ventilation, indoor air quality, or HVAC performance.

This report applies to split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts). For all other permutations of equipment (e.g., boilers, mini-split / multi-split systems) and distribution systems, Section 1 and 2 are required and Sections 3 through 5 are recommended, but not required.

2. The report shall represent a single system design for a house plan. Check the box for "site-specific design" if the design was created for the specific plan configuration (i.e., elevation, option, orientation, and county) of the home to be certified. Check the box for "group design" if the design was created for a plan that is intended to be built with potentially different configurations (i.e., different elevations, options, and/or orientations). Regardless of the box checked, the system design as documented on this National HVAC Design Report must fall within the following tolerances for the home to be certified:
  - Item 3.3: The outdoor design temperature used in loads are within the limits defined at [energystar.gov/hvacdesigntemps](http://energystar.gov/hvacdesigntemps).
  - Item 3.4: The number of occupants used in loads is within  $\pm 2$  of the home to be certified.
  - Item 3.5: The conditioned floor area used in loads is between 100 sq. ft. smaller and 300 sq. ft. larger than the home to be certified.
  - Item 3.6: The window area used in loads is between 15 sq. ft. smaller and 60 sq. ft. larger than the home to be certified, or, for homes to be certified with >500 sq. ft. of window area, between 3% smaller and 12% larger.
  - Item 3.7: The predominant window SHGC is within 0.1 of the predominant value in the home to be certified.
  - Items 3.10 - 3.12: The sensible, latent, & total heat gain are documented for the orientation of the home to be certified.
  - Item 3.13: The variation in total heat gain across orientations is  $\leq 6$  kBtuh.
  - Item 4.16: The cooling sizing % is within the cooling sizing limit selected.

Provide the National HVAC Design Report to the party you are providing these design services to (i.e., a builder or credentialed HVAC contractor) and to the Home Energy Rater. The report is only required to be provided once per system design, even if multiple homes are built using this design (e.g., in a production environment where the same plan is built multiple times, only one report is required). As long as a report has been provided that falls within these tolerances for the home to be certified, no additional work is required. However, if no report falls within these tolerances or if any aspect of the system design changes, then an additional report will need to be generated prior to certification.

Visit [energystar.gov/newhomeshvacdesign](http://energystar.gov/newhomeshvacdesign) for a tool to assist with group designs and for more information.

3. Check "Yes" if this system is to handle temporary occupant loads. Such a system may be required to accommodate a significant number of guests on a regular or sporadic basis and shall be handled by a supplemental cooling system (e.g., a small, single-package unit or split-coil unit) or by a system that can shift capacity from zone to zone (e.g., a variable volume system).
4. The system shall have at least one supply or exhaust fan with associated ducts and controls. Local exhaust fans are allowed to be part of a whole-house ventilation system. Designers may provide supplemental documentation as needed to document the system design.
5. In "Warm-Humid" climates as defined by 2009 IECC Figure 301.1 (i.e., CZ 1 and portions of CZ 2 and 3A below the white line), it is recommended, but not required, that equipment be specified with sufficient latent capacity to maintain indoor relative humidity at  $\leq 60\%$ .
6. Airflow design rates and run-times shall be determined using ASHRAE 62.2-2010 or later. Designers are permitted, but not required, to use published addenda and/or the 2013 or 2016 version of the standard to assess compliance.
7. In addition, consult manufacturer requirements to ensure return air temperature requirements are met.
8. Whole-house mechanical ventilation fans shall be rated for sound at no less than the airflow rate in Item 2.3. Fans exempted from this requirement include HVAC air handler fans, remote-mounted fans, and intermittent fans rated  $\geq 400$  CFM. To be considered for this exemption, a remote-mounted fan must be mounted outside the habitable spaces, bathrooms, toilets, and hallways and there shall be  $\geq 4$  ft. ductwork between the fan and intake grill. Per ASHRAE 62.2-2010, habitable spaces are intended for continual human occupancy; such space generally includes areas used for living, sleeping, dining, and cooking but does not generally include bathrooms, toilets, hallways, storage areas, closets, or utility rooms.
9. Bathroom fans with a rated flow rate  $\geq 500$  CFM are exempted from the requirement to be ENERGY STAR certified.
10. Without proper maintenance, ventilation air inlet screens often become filled with debris. Therefore, EPA recommends, but does not require, that these ventilation air inlets be located so as to facilitate access and regular service by the occupant.
11. Select "2013 ASHRAE Fundamentals" if using Chapter 17 of the 2013 ASHRAE Handbook of Fundamentals. Select "Other per AHJ" if the Authority Having Jurisdiction where the home will be certified mandates the use of a load calculation methodology other than Unabridged ACCA Manual J v8 or 2013 ASHRAE Fundamentals.
12. Visit [energystar.gov/hvacdesigntemps](http://energystar.gov/hvacdesigntemps) for the maximum cooling season design temperature and minimum heating season design temperature permitted for ENERGY STAR certified homes. For "County & State, or US Territory, selected", select the County and State or US Territory (i.e., Guam, Northern Mariana Islands, Puerto Rico, or US Virgin Islands), where the home is to be certified. The same design report is permitted to be used in other counties, as long as the design temperature limits in those other counties meet or exceed the cooling and heating season temperature limits for the county selected. For example, if Fauquier County, VA, is used for the load calculations, with a 1% cooling temperature limit of 93 F, then the same report could be used in Fairfax County (which has a higher limit of 94 F) but not in Arlington County (which has a lower limit of 92 F). If a jurisdiction-specified design temperature is used that exceeds the limit in the ENERGY STAR Certified Homes Design Temperature Limit Reference Guide, designers must submit a [Design Temperature Exception Request](#).



# National HVAC Design Report <sup>1</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

13. To determine the number of occupants among all HVAC systems in the home, calculate the number of bedrooms, as defined below, and add one. This number of occupants must be within  $\pm 2$  of the home to be certified, unless Item 1.5 indicates that the system is a cooling system for temporary occupant loads.

A bedroom is defined by ANSI / RESNET / ICC Standard 301-2014 as a room or space 70 sq. ft. or greater size, with egress window and closet, used or intended to be used for sleeping. A “den”, “library”, or “home office” with a closet, egress window, and 70 sq. ft. or greater size or other similar rooms shall count as a bedroom, but living rooms and foyers shall not.

An egress window, as defined in 2009 IRC section R310, shall refer to any operable window that provides for a means of escape and access for rescue in the event of an emergency. The egress window definition has been summarized for convenience. The egress window shall:

  - have a sill height of not more than 44 inches above the floor; AND
  - have a minimum net clear opening of 5.7 sq. ft.; AND
  - have a minimum net clear opening height of 24 in.; AND
  - have a minimum net clear opening width of 20 in.; AND
  - be operational from the inside of the room without the use of keys, tools or special knowledge.
14. “Predominant” is defined as the SHGC value used in the greatest amount of window area in the home.
15. Infiltration rate shall reflect the value used in the confirmed or projected ERI rating for home to be certified. Alternatively, use “Average” or “Semi-loose” values for the cooling season infiltration rate and “Semi-tight” or “Average” values for the heating season infiltration rate, as defined by ACCA Manual J, Eighth Edition, Version Two.
16. Orientation represents the direction that the front door of the house is facing. The designer is only required to document the loads for the orientation(s) that the house might be built in. For example, if a house plan will only be built one time in a specific orientation (e.g., a site-specific design), then the designer only needs to document the loads for this one orientation.
17. Determine the orientation with the largest and smallest Total Heat Gain. Verify that the difference in Total Heat Gain between the orientation with the largest and smallest value is  $\leq 6$  kBtuh. If not, then assign the orientations into one or more groups until the difference is  $\leq 6$  kBtuh and then complete a separate National HVAC Design Report for each group.
18. Equipment shall be selected using the maximum total heat gain in Item 3.12 and the total heat loss in Item 3.14 per ACCA Manual S, Second Edition, except that cooling ranges above ACCA Manual S limits are temporarily allowed, per Item 4.15.
19. As an alternative for low-load spaces, a system match-up including a single-speed compressor with a total capacity  $\leq 20$  kBtuh is permitted to be used in spaces with a total cooling load  $\leq 15$  kBtuh. A system match-up including a two-speed or variable-speed compressor with a total capacity  $\leq 25$  kBtuh is permitted to be used in spaces with a total cooling load  $\leq 18$  kBtuh.
20. If an AHRI Reference # is not available, OEM-provided documentation shall be attached with the rated efficiency of the specific combination of indoor and outdoor components of the air conditioner or heat pump, along with confirmation that the two components are designed to be used together.
21. Per ACCA Manual S, Second Edition, if the load sensible heat ratio is  $\geq 95\%$  and the HDD/CDD ratio is  $\geq 2.0$ , then the Climate is Condition B, otherwise it is Condition A.
22. Design HVAC fan airflow is the design airflow for the blower in CFM, as determined using the manufacturer’s expanded performance data.
23. Design HVAC fan speed setting is the fan speed setting on the control board (e.g., low, medium, high) that corresponds with the Design HVAC fan airflow.
24. Design total external static pressure is the pressure corresponding to the Design HVAC fan airflow, inclusive of external components (e.g., evaporator coil, whole-house humidifier, or  $\geq$  MERV 6 filter).
25. Designers may provide supplemental documentation with room-by-room and total design airflows in lieu of completing Item 5.5. Sample supplemental documentation can be found at <http://www.energystar.gov/newhomeshvacdesign>.
26. Orientation-specific room-by-room design airflows are recommended, but not required, to distribute airflow proportional to load, thereby improving comfort and efficiency.



# National HVAC Commissioning Checklist <sup>1, 2</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### HVAC Commissioning Contractor Responsibilities:

- The commissioning contractor must be credentialed by an HVAC oversight organization to complete this checklist. One checklist must be completed and signed by the commissioning contractor for each HVAC system that is commissioned.
- The completed checklist for each commissioned system, along with the corresponding National HVAC Design Report, shall be retained by the contractor for a minimum of three years for quality assurance purposes. Furthermore, the contractor shall provide the completed checklist to the builder, the Home Energy Rater responsible for certifying the home, and the HVAC oversight organization upon request.
- Visit [www.energystar.gov/newhomeshvac](http://www.energystar.gov/newhomeshvac) for information about the credential requirement and this checklist.

### 1. Commissioning Overview

1.1 Contractor name \_\_\_\_\_ Contractor company \_\_\_\_\_ Date \_\_\_\_\_

1.2 Organization that your company is credentialed with:  ACCA  Advanced Energy  NYSERDA

1.3 Builder client name: \_\_\_\_\_

1.4 Home address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip code: \_\_\_\_\_

1.5 National HVAC Design Report corresponding to this system has been collected from designer or builder.  Contractor-verified

1.6 Area that system serves, per Item 1.4 of National HVAC Design Report:  Whole-house  Upper-level  Lower-level  Other \_\_\_\_\_

1.7 House plan, per Item 1.6 of National HVAC Design Report: \_\_\_\_\_  Site-specific design  Group design #: \_\_\_\_\_

### 2. Refrigerant Charge - Run system for 15 minutes before testing. If outdoor ambient temperature at the condenser is $\leq 55^{\circ}\text{F}$ or, if known, below the manufacturer-recommended minimum operating temperature for the cooling cycle, then the system shall include a TXV, the outdoor temperature shall be recorded in Item 2.1, and the contractor shall check "N/A" in this Section. <sup>3</sup>

	Contractor Verified	N/A
2.1 Outdoor ambient temperature at condenser: _____ $^{\circ}\text{F}$ DB	-	-
2.2 Return-side air temperature inside duct near evaporator, during cooling mode: _____ $^{\circ}\text{F}$ WB	-	<input type="checkbox"/>
2.3 Liquid line pressure: _____ psig	-	<input type="checkbox"/>
2.4 Liquid line temperature: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>
2.5 Suction line pressure: _____ psig	-	<input type="checkbox"/>
2.6 Suction line temperature: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>

#### For System with Thermal Expansion Valve (TXV):

2.7 Condenser saturation temperature: _____ $^{\circ}\text{F}$ DB (Using Item 2.3)	-	<input type="checkbox"/>
2.8 Subcooling value: _____ $^{\circ}\text{F}$ DB (Item 2.7 - Item 2.4)	-	<input type="checkbox"/>
2.9 OEM subcooling goal: _____ $^{\circ}\text{F}$ DB	-	<input type="checkbox"/>
2.10 Subcooling deviation: _____ $^{\circ}\text{F}$ DB (Item 2.8 – Item 2.9)	-	<input type="checkbox"/>

#### For System with Fixed Orifice:

2.11 Evaporator saturation temperature: _____ $^{\circ}\text{F}$ DB (Using Item 2.5)	-	<input type="checkbox"/>
2.12 Superheat value: _____ $^{\circ}\text{F}$ DB (Item 2.6 – Item 2.11)	-	<input type="checkbox"/>
2.13 OEM superheat goal: _____ $^{\circ}\text{F}$ DB (Using superheat tables and Items 2.1 & 2.2)	-	<input type="checkbox"/>
2.14 Superheat deviation: _____ $^{\circ}\text{F}$ DB (Item 2.12 – Item 2.13)	-	<input type="checkbox"/>

2.15 Item 2.10 is  $\pm 3^{\circ}\text{F}$  or Item 2.14 is  $\pm 5^{\circ}\text{F}$

2.16 An OEM test procedure (e.g., as defined for a ground-source heat pump) has been used in place of the sub-cooling or super-heat process and documentation has been attached that defines this procedure

### 3. Indoor HVAC Fan Airflow

3.1 The mode with the higher design HVAC fan airflow used, per Item 5.2 of National HVAC Design Report: <input type="checkbox"/> Heating <input type="checkbox"/> Cooling	<input type="checkbox"/>	-
3.2 Static pressure test holes have been created, and test hole locations are well-marked and accessible.	<input type="checkbox"/>	-
Test hole location for <b>return</b> external static pressure: <input type="checkbox"/> Plenum <input type="checkbox"/> Cabinet <input type="checkbox"/> Transition <input type="checkbox"/> Other: _____	-	-
Test hole location for <b>supply</b> external static pressure: <input type="checkbox"/> Plenum <input type="checkbox"/> Cabinet <input type="checkbox"/> Transition <input type="checkbox"/> Other: _____	-	-
3.3 Measured <b>return</b> external static pressure (Enter value only, without negative sign): _____ IWC	-	-
3.4 Measured <b>supply</b> external static pressure (Enter value only, without positive sign): _____ IWC	-	-
3.5 Measured <b>total</b> external static pressure = Value-only from Item 3.3 + Value-only from Item 3.4 = _____ IWC	-	-
3.6 <b>Measured</b> (Item 3.5) - <b>Design</b> (Item 5.4 on National HVAC Design Report) total external static pressure = _____ IWC	-	-
3.7 Measured HVAC fan airflow, using Item 3.5 and fan speed setting: _____ CFM	-	-
3.8 Measured HVAC fan airflow (Item 3.7) is $\pm 15\%$ of design HVAC fan airflow (Item 5.2 on National HVAC Design Report)	<input type="checkbox"/>	-

### 4. Air Balancing of Supply Registers & Return Grilles (Recommended, but not Required) <sup>4</sup>

4.1 Balancing report attached with room-by-room design airflows from Item 5.5 on National HVAC Design Report, and contractor-measured airflow using ANSI / ACCA 5 QI-2015 protocol	<input type="checkbox"/>	<input type="checkbox"/>
4.2 Room-by-room airflows verified by contractor to be within the greater of $\pm 20\%$ or 25 CFM of design airflow	<input type="checkbox"/>	<input type="checkbox"/>



# National HVAC Commissioning Checklist <sup>1, 2</sup>

## ENERGY STAR Certified Homes, Version 3 / 3.1 (Rev. 09)

### Footnotes

1. This Checklist is designed to align with the requirements of ANSI / ACCA's 5 QI-2015 protocol, thereby improving the performance of HVAC equipment in new homes when compared to homes built to minimum code. However, these features alone cannot prevent all ventilation, indoor air quality, and HVAC problems (e.g., those caused by a lack of maintenance or occupant behavior). Therefore, this Checklist is not a guarantee of proper ventilation, indoor air quality, or HVAC performance.  
This Checklist applies to split air conditioners, unitary air conditioners, air-source heat pumps, and water-source (i.e., geothermal) heat pumps up to 65 kBtuh with forced-air distribution systems (i.e., ducts) and to furnaces up to 225 kBtuh with forced-air distribution systems (i.e., ducts). All other permutations of equipment (e.g., boilers, mini-split / multi-split systems) and distribution systems are exempt.
2. For a home certified in the State of ID, MT, OR, or WA, the following alternatives and exemptions apply:
  - a. For a home with an air-source heat pump up to 65 kBtuh with a forced-air distribution system (i.e., ducts), the contractor is permitted to complete the 2011 PTCS<sup>®</sup> Commissioned Heat Pump Certificate and Startup Form in lieu of this Checklist.
  - b. For a home with a split air conditioner or unitary air conditioner up to 65 kBtuh with a forced-air distribution system (i.e., ducts), the contractor is permitted to complete the Northwest Central AC Commissioning & Startup Form in lieu of this Checklist.
  - c. For a home in a location with < 600 CDD, the completion of this Checklist is recommended, but not required.
3. Either factory-installed or field-installed TXV's may be used. For field-installed TXV's, ensure that sensing bulbs are insulated and tightly clamped to the vapor line with good linear thermal contact at the recommended orientation, usually 4 or 8 o'clock.
4. Air balancing of supply registers and return grilles is highly recommended to improve the performance of the HVAC system and comfort of the occupants, but is not required at this time for certification. When air balancing is completed, balancing dampers or proper duct sizing shall be used instead of looped or coiled ductwork to limit flow to diffusers. When balancing dampers are used, they shall be located at the trunk to limit noise unless the trunk will not be accessible when the balancing process is conducted. In such cases, Opposable Blade Dampers (OBD) or dampers located in the duct boot are permitted to be used.





# ENERGY STAR Certified Homes, Version 3 (Rev. 07) Water Management System Builder Checklist <sup>1,2</sup>

Home Address: \_\_\_\_\_ City: \_\_\_\_\_ State: \_\_\_\_\_ Zip Code: \_\_\_\_\_

1. Water-Managed Site and Foundation	Must Correct	Builder Verified	Rater Verified	N/A
1.1 Patio slabs, porch slabs, walks, and driveways sloped $\geq 0.25$ in. per ft. away from home to edge of surface or 10 ft., whichever is less. <sup>3</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.2 Back-fill has been tamped and final grade sloped $\geq 0.5$ in. per ft. away from home for $\geq 10$ ft. See Footnote for alternatives. <sup>3</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.3 Capillary break beneath all slabs (e.g., slab on grade, basement slab) except crawlspace slabs using either: $\geq 6$ mil polyethylene sheeting, lapped 6-12 in., or $\geq 1$ in. extruded polystyrene insulation with taped joints. <sup>4, 5, 6</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4 Capillary break at all crawlspace floors using $\geq 6$ mil polyethylene sheeting, lapped 6-12 in., & installed using one of the following opt's: <sup>4, 5, 6</sup>				
1.4.1 Placed beneath a concrete slab; OR,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4.2 Lapped up each wall or pier and fastened with furring strips or equivalent; OR,	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.4.3 Secured in the ground at the perimeter using stakes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.5 Exterior surface of below-grade walls of basements & unvented crawlspaces finished as follows: a) For poured concrete, masonry, & insulated concrete forms, finish with damp-proofing coating. <sup>7</sup> b) For wood framed walls, finish with polyethylene and adhesive or other equivalent waterproofing.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.6 Class 1 vapor retarder not installed on interior side of air permeable insulation in ext. below-grade walls. <sup>8</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.7 Sump pump covers mechanically attached with full gasket seal or equivalent.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1.8 Drain tile installed at the exterior side of footings of basement and crawlspace walls, with the top of the drain tile pipe below the bottom of the concrete slab or crawlspace floor. Drain tile surrounded with $\geq 6$ in. of $\frac{1}{2}$ to $\frac{3}{4}$ in. washed or clean gravel and with gravel layer fully wrapped with fabric cloth. Drain tile level or sloped to discharge to outside grade (daylight) or to a sump pump. <sup>9</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>2. Water-Managed Wall Assembly</b>				
2.1 Flashing at bottom of exterior walls with weep holes included for masonry veneer and weep screed for stucco cladding systems, or equivalent drainage system. <sup>10</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.2 Fully sealed continuous drainage plane behind exterior cladding that laps over flashing in Item 2.1 and fully sealed at all penetrations. Additional bond-break drainage plane layer provided behind all stucco and non-structural masonry cladding wall assemblies. <sup>10, 11</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.3 Window and door openings fully flashed. <sup>12</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>3. Water-Managed Roof Assembly</b>				
3.1 Step and kick-out flashing at all roof-wall intersections, extending $\geq 4$ " on wall surface above roof deck and integrated shingle-style with drainage plane above; boot / collar flashing at all roof penetrations. <sup>13</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.2 For homes that don't have a slab-on-grade foundation and do have expansive or collapsible soils, gutters & downspouts provided that empty to lateral piping that discharges water on sloping final grade $\geq 5$ ft. from foundation, or to underground catchment system not connected to the foundation drain system that discharges water $\geq 10$ ft. from foundation. See Footnote for alternatives & exemptions. <sup>4, 14</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.3 Self-sealing bituminous membrane or equivalent at all valleys & roof deck penetrations. <sup>4</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.4 In 2009 IECC Climate Zones 5 & higher, self-sealing bituminous membrane or equivalent over sheathing at eaves from the edge of the roof line to $> 2$ ft. up roof deck from the interior plane of the exterior wall. <sup>4</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>4. Water-Managed Building Materials</b>				
4.1 Wall-to-wall carpet not installed within 2.5 ft. of toilets, tubs, and showers.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.2 Cement board or equivalent moisture-resistant backing material installed on all walls behind tub and shower enclosures composed of tile or panel assemblies with caulked joints. Paper-faced backerboard shall not be used. <sup>15</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.3 In Warm-Humid climates, Class 1 vapor retarders not installed on the interior side of air permeable insulation in above-grade walls, except at shower and tub walls. <sup>8</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.4 Building materials with visible signs of water damage or mold not installed or allowed to remain. <sup>16</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.5 Framing members & insulation products having high moisture content not enclosed (e.g., with drywall) <sup>17</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Builder Employee: _____ Builder Signature: _____ Date: _____				
Builder has completed Builder Checklist in its entirety, except for items that are checked in the Rater Verified column (if any) <sup>2</sup> Rater Signature: _____ Date: _____				

## Notes:

- The specifications in this Checklist are designed to help improve moisture control in new homes compared with homes built to minimum code. However, these features alone cannot prevent all moisture problems. For example, leaky pipes or overflowing sinks or baths can lead to moisture issues and negatively impact the performance of this Checklist's specified features.



# ENERGY STAR Certified Homes, Version 3 (Rev. 07)

## Water Management System Builder Checklist<sup>1,2</sup>

2. Upon completion, the builder shall return the Checklist to the Rater for review. Alternatively, at the discretion of the builder and Rater, the Rater may verify any item on this Checklist. When this occurs, the Rater shall check the box of the verified items in the Rater Verified column. The Rater is only responsible for ensuring that the builder has completed the Builder Checklist in its entirety and for verifying the items that are checked in the Rater Verified column (if any). The Rater is not responsible for assessing the accuracy of the field verifications for items in this Checklist that are not checked in the Rater Verified column. Instead, it is the builder's exclusive responsibility to ensure the design and installation comply with the Checklist.
3. Swales or drains designed to carry water from foundation are permitted to be provided as an alternative to the slope requirements for any home, and shall be provided for a home where setbacks limit space to less than 10 ft. Also, tamping of back-fill is not required if either: proper drainage can be achieved using non-settling compact soils, as determined by a certified hydrologist, soil scientist, or engineer; OR, the builder has scheduled a site visit to provide in-fill and final grading after settling has occurred (e.g., after the first rainy season).
4. Not required in Dry (B) climates as shown in 2009 IECC Figure 301.1 and Table 301.1.
5. Not required for raised pier foundations with no walls. To earn the ENERGY STAR, EPA recommends, but does not require, that radon-resistant features be included in homes built in EPA Radon Zones 1, 2 & 3. For more information, see [www.epa.gov/indoorairplus](http://www.epa.gov/indoorairplus).
6. For an existing slab (e.g., in a home undergoing a gut rehabilitation), in lieu of a capillary break beneath the slab, a continuous and sealed Class I or Class II Vapor Retarder (per Footnote 8) is permitted to be installed on top of the entire slab. In such cases, up to 10% of the slab surface is permitted to be exempted from this requirement (e.g., for sill plates). In addition, for existing slabs in occupiable space, the Vapor Retarder shall be, or shall be protected by, a durable floor surface. If Class I Vapor Retarders are installed, they shall not be installed on the interior side of air permeable insulation or materials prone to moisture damage.
7. Interior surface of existing below-grade wall (e.g., in a home undergoing a gut rehab.) listed in Item 1.5a is permitted to be finished by:
  - Installing a continuous and sealed drainage plane, capillary break, Class I Vapor Retarder (per Footnote 8) and air barrier that terminates into a foundation drainage system as specified in Item 1.8; OR
  - If a drain tile is not required as specified in Footnote 9, adhering a capillary break and Class I Vapor Retarder (per Footnote 6) directly to the wall with the edges taped/sealed to make it continuous.

Note that no alternative compliance option is provided for existing below-grade wood-framed walls in Item 1.5b.

8. The 2009 IRC defines Class I vapor retarders as a material or assembly with a rating of  $\leq 0.1$  perm, as defined using the desiccant method with Procedure A of ASTM E 96. The following materials are typically rated at  $\leq 0.1$  perm and therefore shall not be used on the interior side of air permeable insulation in above-grade exterior walls in warm-humid climates or below-grade exterior walls in any climate: rubber membranes, polyethylene film, glass, aluminum foil, sheet metal, foil-faced insulating sheathings, and foil-faced non-insulating sheathings. These materials can be used on the interior side of walls if air permeable insulation is not present (e.g., foil-faced rigid foam board adjacent to a below-grade concrete foundation wall is permitted).

Note that this list is not comprehensive and other materials with a perm rating  $\leq 0.1$  also shall not be used. Also, if manufacturer specifications for a specific product indicate a perm rating above 0.1, then the material may be used, even if it is in this list. Also note that open-cell and closed-cell foam generally have perm ratings above this limit and may be used unless manufacturer specifications indicate a perm rating  $\leq 0.1$ . Several exemptions to these requirements apply:

- Class I vapor retarders, such as ceramic tile, may be used at shower and tub walls;
  - Class I vapor retarders, such as mirrors, may be used if mounted with clips or other spacers that allow air to circulate behind them.
9. Alternatively, either a drain tile that is pre-wrapped with a fabric filter or a Composite Foundation Drainage System (CFDS) that has been evaluated by ICC-ES per AC 243 are permitted to be used to meet this Item. Note that the CFDS must include a soil strip drain or another ICC-ES evaluated perimeter drainage system to be eligible for use. In an existing home (e.g. in a home undergoing a gut rehab.) a drain tile installed only on the interior side of the footings is permitted. Additionally, a drain tile is not required when a certified hydrologist, soil scientist, or engineer has determined that a crawlspace foundation, or an existing basement foundation (e.g., in a home undergoing a gut rehab.), is installed in Group I Soils (i.e. well-drained ground or sand-gravel mixture soils), as defined by 2009 IRC Table R405.1.
  10. These Items not required for existing structural masonry walls (e.g., in a home undergoing a gut rehabilitation). Note this exemption does not extend to existing wall assemblies with masonry veneers.
  11. Any of the following systems may be used: a monolithic weather-resistant barrier (i.e., house wrap) shingled at horizontal joints and sealed or taped at all joints; weather resistant sheathings (e.g., faced rigid insulation) fully taped at all "butt" joints; lapped shingle-style building paper or felts; or other water-resistive barrier recognized by ICC-ES or other accredited agency.
  12. Apply pan flashing over the rough sill framing, inclusive of the corners of the sill framing; side flashing that extends over pan flashing; and top flashing that extends over side flashing or equivalent details for structural masonry walls.
  13. Intersecting wall siding shall terminate 1 in. above the roof or higher, per manufacturer's recommendations. Continuous flashing shall be installed in place of step flashing for metal and rubber membrane roofs.
  14. The assessment of whether the soil is expansive or collapsible shall be completed by a certified hydrologist, soil scientist, or engineer. As an alternative, a roof design is permitted to be used that deposits rainwater to a grade-level rock bed with a waterproof liner and a lateral drain pipe that meets discharge requirements per Item 3.2. As another alternative, a rainwater harvesting system is permitted to be used that drains overflow to meet discharge requirements per Item 3.2.
  15. In addition to cement board, materials that have been evaluated by ICC-ES per AC 115 may also be used to meet this requirement. Monolithic tub and shower enclosures (e.g., fiberglass with no seams) are exempt from this backing material requirement unless required by the manufacturer. Paper-faced backerboard may only be used behind monolithic enclosures or waterproof membranes that have been evaluated by ICC-ES per AC 115, and then only if it meets ASTM mold-resistant standards ASTM D3273 or ASTM D6329.
  16. If mold is present, effort should be made to remove all visible signs of mold (e.g., by damp wipe with water and detergent). If removal methods are not effective, then the material shall be replaced. However, stains that remain after damp wipe are acceptable. Lumber with "sap stain fungi" is exempt from this Item as long as the lumber is structurally intact.
  17. For wet-applied insulation, follow manufacturer's drying recommendations. EPA recommends that lumber moisture content be  $\leq 18\%$ .



## Home Energy Rating System (HERS) Analysis

**Table 1.1 - Project Summary**

**Project Name** Germantown Crossing  
**Certification Type** LEED for Homes - Energy Star V3  
**Address** 1520 Germantown Street  
**City, State, Zip** Dayton, Ohio 45417

**Building Input Summary**

		Scenario A
Slab Floors		24" deep vertical with a taper
Rim/Band Joist		R-21 batt 2x6 @ 16" o.c.
Above Grade Wall		R-21 batt 2x6 @ 16" o.c.
Windows		0.3      0.3
Doors		Adiabatic
Ceiling w/Attic		R-49 blown, 24" o.c. roof trusses w/ raised heel
Heating/Cooling Equipment		Vertical VRP Heat Pumps 20 SEER, 10 HSPF
Water Heating		Individual, electric 28 gal, 0.92 UEF (0.93 EF)
Programmable Thermostat		Yes
<b>Mechanical Ventilation</b>		30 cfm (1-bed) & 45 cfm (2- ASHRAE 62.2-bed) dual speed 2010 fans, 15 W
Infiltration		7      ACH@50 (to be tested)
Duct Location, Insulation		In conditioned space
Duct Leakage to Outside (energy loss)		0.04      cfm25/SF (TESTED)
Total Duct Leakage (comfort loss)		0.08      cfm25/SF (TESTED)
Lights		100% LED
Refrigerator		ES - 400      Fridge
Dishwasher		None - Default      Dish
Clothes Washer		Default
Dryer/Oven Fuel		Electric Range
Shower gpm		1.5
Lavatory gpm		1.5
Pipes Insulated		none claimed
Recirculation		None (standard system)
Farthest Fixture to DHW (ft)		41      Shower

**Table 1.3 - Unit Summary**

Unit Name Type	Unit Count	LEED Baseline Energy Budget	Energy Star V3 HERS Target (SAF Adjusted)	LEED Energy Budget	HERS Index
1st_2 Bed_Type A	6	199.9	77	83.9	66
1st_2 Bed_Type B	2	198.9	76	89	65
1st_1 Bed_Type C	3	125.9	77	67.2	65
1st_3 Bed_Type D	3	267	76	103.7	66
2nd_2 Bed_Type A	7	199.3	76	81.3	66
2nd_2 Bed_Type B	2	197.8	75	84.5	64
2nd_1 Bed_Type C	3	125.6	77	65.4	65
2nd_3 Bed_Type D	4	266.5	75	100.1	66
2nd_1 Bed_Type E	1	125.2	76	68.3	65
2nd_1 Bed_Type F	1	124.9	76	70	64
3rd_2 Bed_Type A	7	195.7	75	82.4	63
3rd_2 Bed_Type B	2	194.4	74	85.1	62
3rd_1 Bed_Type C	3	124.4	76	66.1	63
3rd_3 Bed_Type D	4	263.8	75	101.4	63
3rd_1 Bed_Type E	1	124.1	75	68.9	63
3rd_1 Bed_Type F	1	123.9	75	70.4	63

**SECTION 03 2000  
CONCRETE REINFORCING**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes:
  - 1. Steel reinforcement bars.
  - 2. Welded-wire reinforcement.
- B. Related Requirements:
  - 1. Section 32 1313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Each type of steel reinforcement.
  - 2. Epoxy repair coating.
  - 3. Zinc repair material.
  - 4. Bar supports.
  - 5. Mechanical splice couplers.
  - 6. Structural thermal break insulated connection system.
- B. Shop Drawings: Comply with ACI SP-066:
  - 1. Include placing drawings that detail fabrication, bending, and placement.
  - 2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
  - 3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars, and dimensions.
- C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.
  - 1. Location of construction joints is subject to approval of Architect.
- D. Welding certificates.
  - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.
- E. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
  - 2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- F. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Steel Reinforcement:
    - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
  - 2. Mechanical splice couplers.
- G. Field quality-control reports.

**1.3 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.
  - 1. Store reinforcement to avoid contact with earth.

2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

## **PART 2 - PRODUCTS**

### **2.1 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970/A970M.
- D. Galvanized Reinforcing Bars:
  1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
  2. Zinc Coating: ASTM A767/A767M, Class I zinc coated after fabrication and bending.
- E. Epoxy-Coated Reinforcing Bars:
  1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
  2. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch bar length.
- F. Dual-Coated Reinforcing Bars: ASTM A1055/A1055M.
  1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
  2. Zinc Coating: ASTM A1055/A1055M Type I.
  3. Epoxy Coating: ASTM A775/A775M with less than 2 percent damaged coating in each 12-inch bar length.
- G. Stainless Steel Reinforcing Bars: ASTM A955/A955M, Grade 60, Type 304, deformed.
- H. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.
- I. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- J. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- K. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.
- L. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, plain steel.

### **2.2 REINFORCEMENT ACCESSORIES**

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
    - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

- D. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; tension-compression type.
- E. Structural Thermal Break Insulated Connection System:
  - 1. Tension Rods: Carbon steel with crimped Type 316 stainless steel rods.
  - 2. Shear Reinforcement Rods: ASTM A276/A276M, Type 316 stainless steel tube.
  - 3. Pressure pads: ASTM A276/A276M, Type 316 stainless steel.
  - 4. Insulation body: Polystyrene.
- F. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Galvanized.
- G. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.
- H. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.
- I. Zinc Repair Material: ASTM A780/A780M.

### **2.3 FABRICATING REINFORCEMENT**

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### **3.2 INSTALLATION OF STEEL REINFORCEMENT**

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.
- H. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.
- I. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.
- J. Dual-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

- K. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780/A780M.

**3.3 JOINTS**

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

**3.4 INSTALLATION TOLERANCES**

- A. Comply with ACI 117.

**3.5 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
  - 1. Steel-reinforcement placement.
  - 2. Steel-reinforcement mechanical splice couplers.
  - 3. Steel-reinforcement welding.

**END OF SECTION 03 2000**

**SECTION 03 3000  
CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Related Sections:
  - 1. Section 32 1313 – Concrete Pavement.
  - 2. Section 07 9200 – Joint Sealants.

**1.2 REFERENCES**

- A. General: Section 01 4200 – Reference Standards
- B. American Society for Testing and Materials (ASTM), current edition of:
  - 1. ASTM A 82 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  - 2. ASTM A 185 Standard Specification for Welded Wire Fabric, Plain, for Concrete Reinforcement
  - 3. ASTM A 615 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - 4. ASTM C 31 Standard Test Methods of Making and Curing Concrete Specimens in the Field
  - 5. ASTM C 33 Standard Specification for Concrete Aggregates
  - 6. ASTM C 39 Standard Test Methods for Compressive Strength of Cylindrical Concrete Specimens.
  - 7. ASTM C 94 Standard Specification for Ready-Mixed Concrete
  - 8. ASTM C 138 Standard Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete
  - 9. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete
  - 10. ASTM C 150 Standard Specification for Portland Cement
  - 11. ASTM C 172 Standard Practice for Sampling Freshly Mixed Concrete
  - 12. ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
  - 13. ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
  - 14. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete
  - 15. ASTM C 309 Standard Specification for Liquid Membrane-Forming Curing Compounds for Curing Concrete
  - 16. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
  - 17. ASTM C 881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
  - 20. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials.
  - 21. ASTM E 303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
  - 22. ASTM E 1155 Standard Test Methods for Determining FF Floor Flatness and FL Floor Levelness Numbers
  - 23. ASTM E 1745 Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granulated Fill Under Concrete Slabs.
- C. American Concrete Institute (ACI).
  - 1. ACI 301, "Specifications for Structural Concrete for Buildings."
  - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
  - 3. ACI 117 "Standard Specifications for Tolerances for Concrete



- 4. ACI 302 Construction and Materials.”
- 4. ACI 302 “Guide for Concrete Floor and Slab Construction.”
- 5. ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.”
- 6. ACI 305 “Hot Weather Concreting.”
- 7. ACI 306 “Cold Weather Concreting.”
- 8. ACI 308 “Standard Practice for Concrete Curing.”
- 9. ACI 309 “Standard Practice for Consolidation of Concrete.”
- 10. ACI 311.4 “Guide for Concrete Inspection.”
- 11. ACI 318 “Building Code Requirements for Reinforced Concrete.
- D. Concrete Reinforcing Steel Institute (CRSI).
  - 1. “Manual of Standard Practice.”

### 1.3 SUBMITTALS

- A. General: Section 01 3000 – Administrative Requirements.
- B. Product data:
  - 1. Form release agent.
  - 2. Admixtures.
  - 3. Curing compounds.
  - 4. Vapor barrier sheet.
  - 5. Concrete sealers and densifiers.
  - 6. Cementitious materials and aggregates.
  - 7. Steel reinforcement and reinforcement accessories.
  - 8. Bonding agents.
  - 9. Repair materials.
- C. Material certificates for mix design in lieu of material laboratory test reports, signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements.
- D. Joint Plan: Provide detailed plan showing proposed locations of control joints in concrete slabs.

### 1.4 QUALITY ASSURANCE

- A. General: Refer to Section 01 4000 – Quality Requirements.
- B. Field Quality Control Testing: Refer to the Conditions of the Contract.

## PART 2 – PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. Refer to Section 01 6000 – Product Requirements.

### 2.2 FORM

- A. Forms: Plywood, lumber, metal, or another acceptable material.
- B. Form Release Agent: Commercial formulation, non-staining, V.O.C. content 340 grams per liter maximum.
- C. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties.

### 2.3 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
  - 1. Refer to Structural Notes on the Drawings for scheduled sizes.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric, flat sheets only.
- D. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices complying With CRSI specifications.

## 2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I.
- B. Aggregates:
  - 1. Normal-weight aggregates: ASTM C 33,
  - 2. Light-weight aggregates: ASTM C330
  - 3. Exterior surfaces coarse aggregate shall be crushed limestone.
- C. Water: Potable.

## 2.5 RELATED MATERIALS

- A. Vapor Barrier for Interior Slabs-on-Grade:
  - 1. Vapor transmission rate: Not exceeding 0.036 gr./ft<sup>2</sup>/hr. (ASTM E 96).
  - 2. Puncture resistance: Minimum 2340 grams (ASTM E 1709).
  - 3. Tensile Strength: Minimum 54.4 lbf/in. (ASTM D 882).
  - 4. Acceptable Products:
    - a. *Stego Wrap* (10- mil), Stego Industries LLC.
    - b. *Vapor Mat*, W.R. Meadows, Inc.
    - c. *Vaporguard*, Reef Industries.
    - d. Accessories: High-density polyethylene tape by vapor barrier manufacturer.
- B. Moisture-Retaining Cover for Curing: 10 oz. bulap laminated to 4 mils white polyethylene sheet.
- C. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type I, Class A.
- D. Bonding Agent: Polyvinyl acetate or acrylic base.
- E. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

## 2.6 PROPORTIONING AND DESIGNING MIXES

- A. Design mixes: Refer to Structural drawings for critical properties of concrete mixes.

## 2.7 ADMIXTURES

- A. General: Admixtures shall not contain more than 0.1 percent chloride ions.
- B. Concrete Admixtures:
  - 1. Air-Entraining Admixture: ASTM C 260.
  - 2. Water-Reducing Admixture: ASTM C 494, Type A.
  - 3. High-Range Water-Reducing Admixture, Super Plasticizer: ASTM C 494, Type F.
  - 4. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.
  - 5. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

## 2.8 CONCRETE SEALERS AND DENSIFIERS

- A. Concrete sealer: USDA-approved water-based aliphatic urethane, minimum 30 percent solids, non-yellowing, formulated for sealing and dustproofing concrete.
  - 1. Location: Apply to interior concrete slabs not scheduled to receive an applied finish material.
- B. Concrete densifier (hardener): USDA-approved penetrating densifier, resistant to automotive fluids, salt, animal fats and fluids, organic acids, and alkalai compounds, with no reduction in the slip resistance of the concrete surface to which it is applied.
  - 1. Location: Apply to interior concrete slabs subject to heavy vehicular and pedestrian traffic.

## 2.9 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.

- B. Design mixes to provide normal weight concrete with the properties as indicated on the Drawings and in Structural Notes.
- C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Owner.

## **2.10 ADMIXTURES**

- A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
- B. Use air-entraining admixture in exterior exposed concrete at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent the limits stated in Structural Notes and in accordance with ASTM C 94, Table 3.
- C. Use admixtures for water reduction and retarding in strict compliance with manufacturer's directions.

## **2.11 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as follows:
  - 1. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution and Closeout Requirements.

### **3.2 FORMS**

- A. Formwork Tolerances: Comply with the following ACI 347 limits:
  - 1. Provide Class A tolerances for concrete surfaces exposed to view.
  - 2. Provide Class C tolerances for other concrete surfaces.
- B. General: Coat contact surfaces of forms with form-coating compound prior to placing reinforcement. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

### **3.3 VAPOR BARRIER INSTALLATION**

- A. General: Place sheeting in position with longest dimension parallel with direction of pour. Vapor barrier shall be placed in accordance with manufacturer's instructions.
- B. Lap joints and seal with manufacturer's recommended pressure-sensitive tape.

### **3.4 PLACING REINFORCEMENT**

- A. General: Comply with CRSI's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as indicated on Structural Drawings and "General Notes."
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Architect.
- C. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
- D. Install welded wire fabric in sheets only. 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.

### 3.5 INSTALLING EMBEDDED ITEMS

- A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.
- B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

### 3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.
- E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
  - 1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
  - 2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
  - 3. Maintain reinforcing in proper position on chairs during concrete placement.
- F. Cold-Weather Placement: Comply with provisions of ACI 306. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
  - 1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - 2. Do not use calcium chloride, salt, or other materials containing antifreeze agents. Do not use chemical accelerators unless otherwise accepted in mix designs.
- G. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305.

### 3.7 JOINTS

- A. Contraction (Control) Joints in Slabs: Saw cuts 1/8 inch wide by 1/4 of slab depth.

### 3.8 MONOLITHIC SLAB FINISHES

- A. Slab finish designations specified comply with ASTM E 1155.
- B. Float Finish (Fit-Fn) - Not Critical Floor Tolerance:
  - 1. Specified Overall Value: FF 25/FL 20.
  - 2. Minimum Local Value: FF 20/FL 17.
  - 3. Apply float finish to monolithic slab surfaces that are to receive trowel finish.
- C. Trowel Finish 1 (Tr-Fn1) - Normal Sized Rooms (Under 1,000 sq.ft.):

1. Specified Overall Value: FF 30/FL 23.
  2. Minimum Local Value: FF 25/FL 20.
  3. Apply trowel finish to slab surfaces that are to be covered with resilient flooring.
- D. Trowel Finish 2 (Tr-Fn2) - Large Rooms (Over 1,000 sq.ft.):
1. Specified Overall Value: FF 36/FL 25.
  2. Minimum Local Value: FF 30/FL 22.
  3. Apply trowel finish to monolithic slab surfaces that are to receive resilient flooring, carpet, or other thin finish system.
- E. Nonslip Broom Finish (NsBrm-Fn): Apply nonslip broom finish to exterior concrete.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom, perpendicular to main traffic route.

### **3.9 MISCELLANEOUS CONCRETE ITEMS**

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

### **3.10 CONCRETE CURING AND PROTECTION**

- A. General: Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.
- C. Do not use membrane-forming curing compounds for curing slabs to receive hardeners, sealers, or applied finishes. Perform wet curing with polyethylene coated burlap cover.
- D. Apply floor hardeners and sealers in accordance with the manufacturer's instructions.

### **3.11 REMOVING FORMS**

- A. General: Formwork not supporting weight of concrete, such as sides of walls and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

### **3.12 REUSING FORMS**

- A. Clean and repair surfaces of forms to be reused in the Work.

### **3.13 CONCRETE SURFACE REPAIRS**

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Architect.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface.

- Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
1. Repair finished unformed surfaces containing defects that affect durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
  2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
  3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar.
  4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete.
- E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior approval of Architect for method and procedure, using specified epoxy adhesive and mortar.

### 3.14 QUALITY CONTROL TESTING

Test	Requirements	Standards	Frequency of Testing
Slump	1. Refer to Structural Drawings.	ASTM C 143	One test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed.
Air Content	1. Refer to Structural Drawings.	ASTM C 231 (pressure method) for normal weight concrete; ASTM C 173 (volumetric method) for lightweight concrete	One test for each day's pour of each type of air-entrained concrete.
Concrete Temperature	In-place temperature of concrete shall not exceed 80 deg F. In-place temperature of concrete shall not be less than 50 deg F.	ACI 304, 305, and 306.	Test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and each time a set of compression test specimens is made.
Compressive Strength	1. Refer to Structural Drawings.	Comply with ASTM C 31; one set of 4 standard cylinders for each compressive strength test. Comply with ASTM C 39.	One set for each day's pour exceeding 5 cu. yds.; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
Unit Weight		ASTM C138	

**Notes:**

1. When frequency of testing will provide fewer than 5 strength tests for a given class of concrete, test from at least 5 randomly selected batches

- or from each batch if fewer than 5 are used.
2. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
  3. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.
  4. Testing service shall provide an on-site cure box for cylinder storage during inclement weather.
  5. For each set of four cylinders, test two at 7 days and two at 28 days. Perform 28-day tests regardless of the results of the 7-day tests.

- D. Test results will be reported in writing to Architect, Structural Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28-day tests

### 3.15 PROTECTION

- A. Protect concrete from damage from construction operations until final acceptance. Erect barricades, signs, and other means of protection as required.
- B. Do not permit pedestrian traffic on concrete surfaces until moisture curing is completed.
- C. Do not permit vehicular traffic on concrete surfaces for a period of 28 days following placement.

**END OF SECTION 03 3000**

**SECTION 03 5400  
CEMENTITIOUS UNDERLAYMENT**

**PART 1 - GENERAL**

**1.1 GENERAL CONDITIONS**

- A. The General Conditions, Modifications to General Conditions, Supplementary or Special Conditions and any Instructions to Bidders shall apply to all Divisions of the work.
- B. The requirements of State, Local or appropriate codes applicable to the work, whichever is the most stringent is a requirement of all Divisions of the work.

**1.2 SUBMITTALS**

- A. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.

**1.3 QUALITY ASSURANCE**

- A. Installer's Qualifications: Installation of Gyp-Crete 2000 (3.2K) shall be by an applicator authorized by the Maxxon Corporation using Maxxon approved mixing and pumping equipment or approved equal.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

**1.5 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for combustibility or flame spread requirements.
- B. Provide certificate of compliance from authority having jurisdiction indicating approval of underlayment materials in the required fire rated assembly.

**1.6 FIELD CONDITIONS**

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Gypsum Cement:
  - 1. Compressive strength: 2500 psi
  - 2. Average thickness: 1-inch
  - 3. Basis of Design: Gyp-Crete 2000/3.2K manufactured by the Maxxon Corporation, or approved equal.
- B. Sand Aggregate: Sand shall be 1/8 inch or less, washed masonry or plaster sand, meeting requirements of Maxxon Corporation Sand Specifications 101, or approved equal.
- C. Mix Water: Potable, free from impurities.
- D. Subfloor Primer: Maxxon Floor Primer or approved equal.
- E. Sealer: Maxxon Overspray or approved equal.

**2.2 MIXING**

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.



## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum bi-products, or other compounds detrimental to underlayment material bond to substrate.

### **3.2 PREPARATION**

- A. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- B. Vacuum clean surfaces.
- C. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- D. Close floor openings. Fill cracks and voids with a quick setting patching or caulking material where leakage of topping could occur.

### **3.3 APPLICATION**

- A. Scheduling: Application of Gyp-Crete 2000/3.2K or approved equal shall not begin until the building is enclosed, including roof, windows, doors and other fenestration. Install after drywall installation unless tenant finish requirements identify partitioning after the pour.
- B. Application: Place topping at 1- inch minimum over wood frame. Spread and screed to a smooth surface. Except at authorized joints, place as continuously as possible until application is complete so that no topping product slurry is placed against topping that has obtained its initial set.
- C. Drying: Provide continuous ventilation and adequate heat to rapidly remove moisture from the area until the topping is dry.
  - 1. To test for dryness, tape a 24 inch by 24 inch section of plastic or high density rubber mat to the surface of the underlayment. After 48-72 hours, if no condensation occurs, the underlayment shall be considered dry. Perform dryness test 5-7 days after pour.

### **3.4 CURING**

- A. Prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

### **3.5 PREPARATION FOR INSTALLATION OF GLUE DOWN FLOOR GOODS**

- A. Sealing: Seal all areas that receive glue down floor goods with Maxxon Overspray or approved equal according to the manufacturer's specifications. Any floor areas where the surface has been damaged shall be cleaned and sealed regardless of floor covering to be used. Where floor goods manufacturers require special adhesive or installation systems, their requirements supersede these recommendations.
- B. Floor Goods Procedures: See the manufacturer's brochure for guidelines for installing finished floor goods.

### **3.6 FIELD QUALITY CONTROL**

- A. Slump Test: topping mix shall be tested for slump as it's being pumped using a 2" by 4" cylinder resulting in a patty size of 8" plus or minus 1" diameter.

### **3.7 PROTECTION**

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

**END OF SECTION 03 5400**

**SECTION 04 2200  
CONCRETE UNIT MASONRY**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry units.
  - 2. Decorative concrete masonry units.
  - 3. Pre-faced concrete masonry units.
  - 4. Steel reinforcing bars.

**1.2 DEFINITIONS**

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
- C. Samples: For each type and color of the following:
  - 1. Exposed CMUs.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.
- B. 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/C 91M for air content.
  - 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

**1.5 FIELD CONDITIONS**

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

**PART 2 - PRODUCTS**

**2.1 UNIT MASONRY, GENERAL**

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- 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.

## **2.2 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.
- B. CMUs: ASTM C 90.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
  - 2. Density Classification: Normal weight.

## **2.3 MORTAR AND GROUT MATERIALS**

- A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM 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/C 91M.
- E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. 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 and mortar pigments, all complying with specified requirements, and containing no other ingredients.
- G. Aggregate for Mortar: ASTM C 144.
  - 1. White-Mortar Aggregates: Natural white sand or crushed white stone.
  - 2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C 404.
- I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
- K. Water: Potable.

## **2.4 REINFORCEMENT**

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to 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. Standard in "Masonry-Joint Reinforcement, General" Paragraph below includes requirements for mill-galvanized carbon steel, hot-dip galvanized carbon steel, and stainless steel. Specifying these materials separately is unnecessary.
- C. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Interior Walls: Hot-dip galvanized, carbon steel.
  - 2. Exterior Walls: Hot-dip galvanized carbon steel.
  - 3. Wire Size for Side Rods: 0.148-inch diameter.
  - 4. Wire Size for Cross Rods: 0.148-inch diameter.
  - 5. Spacing of Cross Rods: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet.

## **2.5 TIES AND ANCHORS**

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

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
  2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
  3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized-steel wire.
  2. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized-steel wire.
- C. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch thick steel sheet, galvanized after fabrication.
  2. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized-steel wire.
  3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.
- D. Partition Top Anchors: 0.105-inch thick metal plate with a 3/8-inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches (long, with ends turned up 2 inches or with cross pins unless otherwise indicated).
1. Corrosion Protection: Epoxy coating 0.020 inch thick.

## 2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 07 6200 "Sheet Metal Flashing and Trim" and as follows:
1. 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.
  2. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
  3. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
- B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
  2. 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 0.030 inch
  3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030.
  4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
  5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch thick.
- C. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

- D. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 6200 "Sheet Metal Flashing and Trim."
- 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.

## **2.7 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.
- B. Preformed Control-Joint Gaskets: Made from 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 felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

## **2.8 MASONRY-CELL FILL**

- A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

## **2.9 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, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
  - 1. For masonry below grade or in contact with earth, use Type S.
  - 2. For reinforced masonry, use Type N.
  - 3. 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.
  - 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
- 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 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  - 2. Proportion grout in accordance with ASTM C 476, Table 1.
  - 3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION, GENERAL**

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### 3.2 TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4- inch
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2- inch.
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4-inch in a story height or 1/2-inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
  - 2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
  - 3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

### 3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- E. 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.
- F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
  - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs 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.

### **3.5 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 elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1.Space reinforcement not more than 16 inches o.c.
  - 2.Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3.Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- 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.

### **3.6 FLASHING**

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1.Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2.At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 3.Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 4.Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

### **3.7 REINFORCED UNIT MASONRY 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.Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- 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 TMS 602/ACI 530.1/ASCE 6 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.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to

perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

- B. Inspections: Special inspections according to Level **B** in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at seven days and at 28 days.

### **3.9 REPAIRING, POINTING, AND CLEANING**

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### **3.10 MASONRY WASTE DISPOSAL**

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION 04 2200**



**SECTION 04 2201  
CLAY BRICK 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 SECTION INCLUDES**

- A. Clay face brick
- B. Mortar and grout
- C. Joint reinforcement, ties and anchoring devices

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Samples of each specified product showing normal texture and color variations.

**1.4 QUALITY ASSURANCE**

- A. Mock-Up: In a location approved by the Architect, erect a stepped sample wall panel including all of the wall components specified in this and subsequent sections. The purpose of the mock-up is to verify material selections and workmanship standards required for the project.
- B. Special Inspection Requirements: In addition to other quality assurance requirements specified in this Section, refer to Special Inspection Requirements specified on the Structural (S-Series) Drawings for additional requirements.

**PART 2 - PRODUCTS**

**2.1 FACE BRICK**

- A. Quality: ASTM C216-95, Grade SW, Type FBS.
- C. Size: Standard.
- D. Special shapes: Include, but not limited to, special fabricated watertables, arches, and solid units; same quality, color, and texture as face brick.

**2.2 MORTAR AND GROUT MATERIALS**

- A. Aggregate for Grout: ASTM C404.
- B. Grout for Unit Masonry: ASTM C476 of consistency at time of placement which will completely fill all spaces intended to receive grout. Refer to the Structural Notes on the Drawings for structural properties of mortar and grout materials.
  - 1. Use fine grout in grout spaces less than 2" in horizontal direction, unless otherwise indicated.
  - 2. Use coarse grout (maximum 3/8" aggregate) in grout spaces 2" or more in least horizontal dimension, unless otherwise indicated.
  - 3. Integral Water Repellent Mortar Admixture: Integral liquid polymeric admixture for mortar added during mixing
    - a. Water permeance of Masonry: Capable of achieving a Class E Rating when evaluated using ASTM E 514 with the test extended to 72 hours, using the rating criteria specified in ASTM E 514-74.
    - b. Mortar additive shall be used in Type M or S Mortar Only.
  - 4. Water: Potable
  - 5. Cold Weather Additives: Do not use cold-weather additives without the written approval of the Architect. The Contractor shall submit proposed cold-weather additives to the Architect for evaluation.

**2.3 REINFORCING STEEL**

- A. Steel Reinforcing Bars: ASTM A615, Grade 60. Refer to the Structural (S-Series) drawings for

## 2.4 ACCESSORIES

- A. Premolded Control Joint Strips: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall. Size and configuration as indicated.
  - 1. Polyvinyl Chloride Complying with ASTM D2287, General Purpose Grade, Designation PVC-63506.
- B. Bond Breaker Strips: Asphalt-Saturated Organic Roofing Felt Complying with ASTM D226, Type I (No. 15 Asphalt Felt)
- C. Weep Vents: Single-piece flexible extrusion made from UV-resistant polypropylene co-polymer, 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.
- D. Cavity Drainage Material: Mortar Net or equivalent, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
- E. Flexible Flashing
  - 1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
    - a. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick, with a 0.015 inch thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- F. Flashing Termination Drip Plates and preformed corner shapes.
  - 1. Provide continuous termination drip plate Type 316 Stainless Steel, 26 gauge, 3" wide with hemmed drip edge and adhesive strip with release paper.
  - 2. Application: Unless otherwise indicated, use the following:
    - a. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing termination drip plates.
- G. Anchor Bolts: Provide steel bolts with hex nuts and flat washers complying with ASTM 307, Grade A, hot-dip galvanized to comply with ASTM C153, Class C, in sizes and configuration indicated.

## 2.5 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard strength general purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated; composed of blended organic and inorganic acids combined with special wetting systems and inhibitors; expressly accepted for intended use by manufacturer of masonry units being cleaned without damaging or discoloring masonry surfaces.

## 2.6 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including coloring pigments, air-entraining agents, accelerators, retarders, water repellent agents, anti-freeze compounds or other admixtures, unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification, for types of mortar required, unless otherwise indicated.
  - 1. Use Type mortar as shown on Drawings.
  - 2. Minimum compressive strength as shown on Drawings.
    - a. Mortar color for clay brick work shall match the clay brick. Submit sample for verification.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Verify that foundations are within tolerances specified.
  - 2. Verify that reinforcing dowels are properly placed.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 4. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections.

### **3.2 INSTALLATION - GENERAL**

- A. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.
- B. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.
- C. Build chases and recesses to accommodate items specified in this Section or in other sections of the Specifications as shown or required. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.
- D. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.
- E. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.
- F. Select and arrange units for exposed unit masonry to provide a uniform blend of colors and textures.
- G. Construction Tolerances
  - 1. Comply with tolerances in ACI 530-1/ASCE 6/TMS 602 and the following:
    - a. Variation from Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20'. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints, do not exceed plus or minus 1/4" in 10'.
    - b. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls, do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
    - c. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
    - d. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

### **3.3 INSTALLATION - MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Bond Pattern: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than

- 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: In each course, rack back 1/2-unit length for 1/2-running bond or 1/3-unit length for 1/3 running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
- E. Built-in Work: As construction progresses, build-in items specified under this and other Sections of these Specifications. Fill in solidly with masonry around built-in items.
1. Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.
  2. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.
  3. Fill cores in hollow concrete masonry units with grout 24" under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.
  4. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
    - a. Install compressible filler in joint between top of partition and underside of structure above.
    - b. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

### 3.4 MORTAR BEDDING AND JOINTING

- A. Lay solid masonry units and brick units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar as follows:
1. In starting course on footings
  2. In all courses of piers
  3. Columns and pilasters
  4. Where adjacent to cells or cavities to be reinforced or filled with concrete or grout. \
  5. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- E. All exposed joints shall be well-tooled to a concave or rodded profile, unless otherwise indicated.
1. Provide raked joints at all vertical scores in scored brick units. Strike to match concave or rodded profile of horizontal joints.
  2. Rake-out expansion joints and joints indicated on Drawings to receive sealant.
  3. Mortar joints shall be struck at a consistent time interval when mortar is at the same medium stiff consistency in order to minimize color variations.
  4. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
  5. Collar Joints: After each course is laid, fill the vertical longitudinal joint between wythes solidly and with mortar for the following masonry work:
    - a. All exterior walls, except cavity walls, and interior walls and partitions.
  6. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.
  7. Corners: Provide interlocking masonry unit bond in each course at corners, unless otherwise shown.

8. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, provide same type of bonding specified for structural bonding between wythes and space as follows:
  - a. Provide individual metal ties at not more than 24" o.c. vertically.
9. Provide weep holes in exterior wythe of cavity wall located immediately above ledges and flashing, spaced 2'-0" o.c., unless otherwise indicated.

### 3.5 MASONRY JOINT REINFORCEMENT

- A. General: Provide continuous masonry joint reinforcement as indicated. Install longitudinal side rods in mortar for their entire length with a minimum cover of 5/8" on exterior side of walls. Lap reinforcing a minimum of 6".
- B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Reinforce walls with continuous horizontal joint reinforcing, unless specifically noted to be omitted.
- D. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend reinforcement units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures and other special conditions.
- E. Space continuous horizontal reinforcement as follows:
  1. For multi-wythe walls (solid or cavity) which are structurally bonded by masonry headers or individual wire ties, space horizontal reinforcement 24" o.c. vertically.
  2. For single-wythe walls, space reinforcement at 16" o.c. vertically, unless otherwise indicated.
  3. For parapets, space reinforcement at 8" o.c. vertically, unless otherwise indicated.
  4. Reinforce masonry openings greater than 1'-0" wide, with horizontal joint reinforcement placed in 2 horizontal joints approximately 8" apart, immediately above the lintel and immediately below the sill. Extend reinforcement a minimum of 2'-0" beyond jambs of the opening, except at control joints.
    - a. In addition to wall reinforcement, provide additional reinforcement at openings as required to comply with the above.

### 3.6 FLASHING

- A. General: Provide concealed flashing in masonry work at, or above, shelf angles, lintels, ledges and other obstructions to the downward flow of water in the wall so as to divert such water to the exterior. Prepare masonry surfaces smooth and free from projections which could puncture flashing. Place through-wall flashing on sloping bed of mortar and cover with mortar. Seal penetrations in flashing with mastic before covering with mortar. Extend flashings through exterior face of masonry and turn down to form drip.
- B. Extend flashing the full length of lintels and shelf angles and minimum of 4" into masonry each end. Extend flashing from exterior face of outer wythe of masonry, through the outer wythe, turned up a minimum of 4", and through the inner wythe to within 1/2" of the interior face of the wall in exposed work. Where interior surface of inner wythe is concealed by furring, carry flashing completely through the inner wythe and turn up approximately 2". At heads and sills, turn up ends not less than 2" to form a pan. Install metal drip plates in location as recommended by flashing manufacturer. Extend metal drip plates on exterior to 1/4 inch past wall surface.
- C. Install flashing to comply with manufacturer's instructions.
- D. Install weep holes in the exterior widths of the head joints of the first course of masonry immediately above embedded flashings. Space 24" o.c., unless otherwise indicated.

### 3.7 LINTELS

- A. Provide masonry lintels where shown and wherever openings of more than 2'-0" for block size units or more than 1'-0" for brick size units are shown without structural steel or other supporting lintels. Provide precast or formed-in-place masonry lintels. Cure precast lintels before handling and installation. Temporarily support formed-in-place lintels.
- B. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.

### **3.8 CONTROL AND EXPANSION JOINTS**

- A. General: Provide vertical and horizontal expansion, control and isolation joints in masonry where shown. Build-in related items as the masonry work progresses.
- B. Build-in non-metallic joint fillers where indicated.

### **3.9 REPAIRING, POINTING AND CLEANING**

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Install new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel. Leave 1/2 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, polyethylene film or waterproof masking tape.

### **3.10 PROTECTION**

- A. Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

**END OF SECTION 04 2201**

**SECTION 04 7200  
CAST STONE MASONRY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Architectural cast stone.

**1.2 RELATED REQUIREMENTS**

- A. Section 04 2200 - Unit Masonry: Installation of cast stone in conjunction with masonry.

**1.3 REFERENCE STANDARDS**

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; current edition.
- B. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; current edition.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; current edition.
- D. ASTM C150/C150M - Standard Specification for Portland Cement; current edition.
- E. ASTM C270 - Standard Specification for Mortar for Unit Masonry; current edition.
- F. ASTM C1364 - Standard Specification for Architectural Cast Stone; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Test results of cast stone components made previously by the manufacturer.
  - 1. Include documentation that products contain not less than 25% post-consumer recycled content.
- B. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
- C. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.
- D. Full-Size Samples, For Review:
  - 1. Basic Shapes: One of each.
  - 2. Accent, Trim and Specialty Shapes: One of each.

**1.5 QUALITY ASSURANCE**

- A. Mock-Up: Provide full size cast stone components for installation in mock-up of exterior wall.
  - 1. Approved mock-up will become standard for appearance and workmanship.
  - 2. Mock-up may remain as part of the completed work, if acceptable.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.
- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

## **PART 2 - PRODUCTS**

### **2.1 ARCHITECTURAL CAST STONE**

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural stone, complying with ASTM C1364.
  - 1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  - 2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
  - 3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
  - 4. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Provide shapes indicated on drawings.
  - 1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
  - 2. Unless otherwise indicated on drawings, provide:
    - a. Wash or slope of 1:12 on exterior horizontal surfaces.
    - b. Drips on projecting components, wherever possible.
    - c. Raised fillets at back of sills and at ends to be built in.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI 318.

### **2.2 MATERIALS**

- A. Portland Cement: ASTM C150.
  - 1. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33, except for gradation; natural or manufactured sands.
- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M deformed bars, galvanized or epoxy coated.
- G. Steel Welded Wire Reinforcement: ASTM A185/A185M, galvanized or epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Mortar: Portland cement-lime, ASTM C270, Type N; do not use masonry cement.
- J. Sealant: As specified in Section 07 9200.
- K. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install cast stone components in conjunction with masonry.
- B. Mechanically anchor cast stone units indicated; set remainder in mortar.
- C. Setting:
  - 1. Drench cast stone components with clear, running water immediately before installation.
  - 2. Set units in a full bed of mortar unless otherwise indicated.
  - 3. Fill vertical joints with mortar.
  - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.
- D. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.



1. Rake mortar joints 3/4 inch (19 mm) for pointing.
  2. Remove excess mortar from face of stone before pointing joints.
  3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
  4. Leave the following joints open for sealant:
    - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
    - b. Joints in projecting units.
    - c. Joints between rigidly anchored units, including soffits, panels, and column covers.
    - d. Joints below lugged sills and stair treads.
    - e. Joints below ledge and relieving angles.
    - f. Joints labeled "expansion joint".
- E. Sealant Joints: Install sealants as specified in Section 07 9200.
- F. Installation Tolerances:
1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
  2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
  3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
  4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.
- G. Repairs: Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
1. Repair with matching touchup material provided by the manufacturer and in accordance with manufacturer's instructions.
  2. Repair methods and results subject to Architect 's approval.

### **3.3 CLEANING**

- A. Keep cast stone components clean as work progresses.
- B. Clean completed exposed cast stone after mortar is thoroughly set and cured.
  1. Wet surfaces with water before applying cleaner.
  2. Apply cleaner to cast stone in accordance with manufacturer's instructions.
  3. Remove cleaner promptly by rinsing thoroughly with clear water.
  4. Do not use acidic cleaners.

### **3.4 PROTECTION**

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

**END OF SECTION 04 7200**

**SECTION 06 0500  
COMMON WORK RESULTS FOR WOOD, PLASTIC, AND COMPOSITES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. General product and work results requirements for subsequent Division 06 Sections.

**1.2 SUBMITTALS**

- A. Sustainable Design Submittals:
  - 1. Chain of Custody Certificates for Certified Wood: Refer to Section 01 8113 – Sustainable Design Requirements for detailed information.
- B. Fire-retardant treatment data and certification from chemical treatment manufacturer that treated materials comply with requirements.
- C. Manufacturer's physical color charts showing the full range of colors, textures, and patterns available for each type of material indicated.
- D. Samples for verification:
  - 1. Lumber products with factory-applied finish, 50 sq. in. for lumber for each finish system and color.
  - 2. Linear Moldings: 2-foot-long section with finished joint. Show complete pattern.
  - 3. Nonlinear Shapes: Full-size unit.
- E. Shop Drawings: Show profiles, thicknesses, finishes, joints, ornamentation, installation tolerances, and anchorage details. Indicate attachment methods, embedded supports, reinforcement, fabrication methods, joint treatments, clearances, and supports.

**1.3 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.
- B. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.
- C. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
  - 1. Northeastern Lumber Manufacturers Association (NeLMA)
  - 2. National Lumber Grades Authority (NLGA)
  - 3. Southern Pine Inspection Bureau (SPIB)
  - 4. West Coast Lumber Inspection Bureau (WCLIB)
  - 5. Western Wood Products Association (WWPA)
- D. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
  - 1. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps and provide grade-compliance certificates issued by inspection agency.
- E. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 1. Provide dressed lumber, S4S, unless otherwise indicated.
  - 2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
  - 3. Provide lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Section 01 6000 for general requirements.

## **1.5 PROJECT CONDITIONS**

- A. Field Measurements: 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.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Refer to Section 01 6000 - Product Requirements and subsequent Division 06 Sections for specific material requirements.
- B. Prohibited Content:
  - 1. Urea formaldehyde

### **2.2 MISCELLANEOUS MATERIALS**

- A. Fasteners and Anchors: Provide nails, screws, and other anchoring devices of the type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible, and complying with applicable Federal Specifications. Provide in sufficient length to penetrate minimum of 1-1/2 inches into substrate, unless otherwise recommended by manufacturer.
  - 1. Where finish carpentry is exposed on exterior or in areas of high relative humidity, provide fasteners and anchorages with a hot-dipped zinc coating complying with ASTM A153, or stainless steel.

### **2.3 FABRICATION**

- A. Wood Moisture Content: Comply with requirements of specified inspection agencies and manufacturer's recommendations for moisture content of carpentry on relative humidity conditions existing during time of fabrication and in installation areas.

### **2.4 PRESERVATIVE-TREATMENT FOR WOOD**

- A. General: Comply with AWWA C2 (lumber) and AWWA C9 (plywood). Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC 's Board of Review.
  - 1. Lumber that is not in contact with the ground and is not used in areas subject to water comply with AWWA C31 with inorganic boron (SBX).
  - 2. Do not use chemicals containing chromium or arsenic.
  - 3. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Pressure treat above ground items with waterborne preservatives to a minimum retention of 0.25 lb/cu. ft. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively. Treat indicated items and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members less than 18 inches above grade.
  - 4. Wood floor plates installed over concrete slabs directly in contact with earth.
- C. Pressure treat wood members in contact with ground or freshwater with waterborne preservatives to a minimum retention of 0.40 lb/cu. ft.
- D. Complete fabrication of treated items before treatment, where possible. If cut after treatment, apply field treatment complying with AWWA M4 to cut surfaces. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

### **2.5 FIRE-RETARDANT-TREATMENT FOR WOOD**

- A. General: Comply with applicable requirements of AWWA C20 (lumber) and AWWA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL;

SGS U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Provide fire treated wood in all concealed areas of construction, as shown or indicated on the drawings, and as required by code.
  2. Research or Evaluation Reports: Provide fire-retardant-treated wood acceptable to authorities having jurisdiction and for which a current model code research or evaluation report exists that evidences compliance of fire-retardant-treated wood for application indicated.
  3. For exposed items indicated to receive stained finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- B. Interior Type A: For interior locations, use chemical formulation that produces treated lumber and plywood with the following properties under conditions present after installation:
1. Bending strength, stiffness, and fastener-holding capacities are not reduced below values published by manufacturer of chemical formulation under elevated temperature and humidity conditions simulating installed conditions when tested by a qualified independent testing agency.
  2. No form of degradation occurs due to acid hydrolysis or other causes related to treatment.
  3. Contact with treated wood does not promote corrosion of metal fasteners.
- C. Exterior Type: Use for exterior locations and where indicated. Comply with ASTM D2898.
- D. After treatment, kiln-dry lumber and plywood to a maximum moisture content of 19 and 15 percent, respectively
- E. Discard damaged or defective pieces.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerance and other conditions affecting installation and performance of finish carpentry. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Do not install materials damaged by water or mold.

### **3.2 PREPARATION**

- A. Clean substrates of projections and substances detrimental to application.
- B. Condition finish carpentry to average prevailing humidity conditions in installation areas before installation, for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.
- C. Prime and backprime lumber for painted finish exposed on the exterior not indicated as factory prefinished. Comply with requirements for surface preparation and application in Section 09 90 00 - Painting.
- D. Ensure that all electrical or other services are in place.

### **3.3 INSTALLATION**

- A. Discard units of material which are unsound, warped, bowed, twisted improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install the work plumb, level, true, and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8" in 8'-0" for plumb and level countertops; and with 1/16" maximum offset in flush adjoining 1/8" maximum offsets in revealed adjoining surfaces.
- C. Scribe and cut work to fit adjoining work, and refinish cut surface or repair damaged finish at cuts.
- D. Finish according to specified requirements.
- E. Anchor carpentry as indicated. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailings, countersunk and filled flush with finished surface, and matching final finish where transparent is indicated.

### **3.4 ADJUSTMENT, CLEANING, FINISHING, AND PROTECTION**

- A. Repair damaged and defective carpentry work wherever possible to eliminate visual and functional defects. Replace woodwork that cannot be repaired to the Owner's satisfaction. Adjust joinery for uniform appearance.
- B. Clean carpentry work on exposed and semi-exposed surfaces. Touch-up factory-applied finishes to restore damaged or soiled areas.
- C. Cleaning: Keep premises in a neat, safe, and orderly condition at all times during execution of this portion of the work, free from the accumulation of sawdust, cut-ends, and debris.
- D. Refer to Division 09 Sections for final finishing requirements.
- E. Provide final protection and maintain conditions necessary to ensure that work will be without damage or deterioration at time of acceptance.

**END OF SECTION 06 0500**

**SECTION 06 1000  
ROUGH CARPENTRY**

**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. Framing with dimension lumber.
  - 2. Wood blocking, cants, and nailers.
  - 3. Wood furring and grounds.
  - 4. Plywood backing panels.
- B. Related Requirements:
  - 1. Section 06 0500 – Common Work Results for Wood, Plastic, and Composites
  - 2. Section 06 1600 –Sheathing

**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 D 5664.
  - 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.
  - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
  - 1. Power-driven fasteners.
  - 2. Powder-actuated fasteners.
  - 3. Expansion anchors.
  - 4. Metal framing anchors.

**1.5 QUALITY ASSURANCE**

- A. Refer to Section 06 0500 – Common Work Results for Wood, Plastic, and Composites.

**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 CHEMICAL TREATMENT**

- A. Refer to Section 06 0500 – Common Work Results for Wood, Plastic, and Composites.

### **2.2 DIMENSION LUMBER FRAMING**

- A. Non-Load-Bearing Interior Partitions: Standard, Stud, or No. 3 grade.
  - 1. Species: One of the following:
    - a. Hem-fir (north); NLGA.
    - b. Mixed southern pine; SPIB.
    - c. Spruce-pine-fir; NLGA.
    - d. Hem-fir; WCLIB, or WWPA.
    - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- B. Load-Bearing Partitions: Construction or No. 2 grade.
  - 1. Application: Exterior walls and interior load-bearing partitions.
  - 2. Species:
    - a. Hem-fir (north); NLGA.
    - b. Southern pine; SPIB.
    - c. Douglas fir-larch; WCLIB or WWPA.
    - d. Mixed southern pine; SPIB.
    - e. Spruce-pine-fir; NLGA.
    - f. Douglas fir-south; WWPA.
    - g. Hem-fir; WCLIB or WWPA.
    - h. Douglas fir-larch (north); NLGA.
    - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

### **2.3 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.
  - 4. Furring.
  - 5. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2.
  - 1. Hem-fir (north); NLGA.
  - 2. Mixed southern pine; SPIB.
  - 3. Spruce-pine-fir; NLGA.
  - 4. Hem-fir; WCLIB or WWPA.
  - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. Concealed boards:
  - 1. Mixed southern pine; No. 2 grade; SPIB.
  - 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
  - 3. Spruce-pine-fir (south) or spruce-pine-fir; [Construction or No. 2 Common] [Standard or No. 3 Common] grade; NeLMA, NLGA, WCLIB, or WWPA.
- 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- nails and damage to paneling.

## 2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

## 2.6 METAL FRAMING ANCHORS

- A. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those specified on the Structural Drawings (S-Series). Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  - 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
  - 1. Use for wood-preservative-treated lumber and where indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
  - 1. Use for exterior locations and where indicated.
- E. Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.
- F. I-Joist Hangers: U-shaped joist hangers with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.
- G. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
- H. Bridging: Rigid, V-section, nailless type, 0.050 inch (1.3 mm) thick, length to suit joist size and spacing.
- I. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.
- J. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.



- K. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches (38 mm) wide by 0.050 inch (1.3 mm) thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.
- L. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick by 36 inches (914 mm) long.
- M. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts or to other hold-downs with threaded rods and designed with first of two bolts placed seven bolt diameters from reinforced base.
- N. Wall Bracing: T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches (29 mm) wide by 9/16 inch (14 mm) deep by 0.034 inch (0.85 mm) thick with hemmed edges.
- O. Wall Bracing: Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch (24 by 24 by 1 mm) thick with hemmed edges.

## 2.7 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- 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 (0.6 mm).
- C. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
  - 1. Adhesives 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. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

## 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. 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.
- C. Shear Wall Panels: Install shear wall panels to comply with manufacturer's written instructions.
- D. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. 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 (406 mm) o.c.
- H. Comply with AWPA 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.
- I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- J. 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.
- K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
  1. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

### **3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION**

- A. Install where indicated and where required for screeding or 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. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- D. Provide permanent grounds of dressed, pressure-preserved-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) 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 WOOD FURRING INSTALLATION**

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches o.c.

### **3.4 WALL AND PARTITION FRAMING INSTALLATION**

- A. General: Provide single bottom plate and double top plates using members of 2-inch nominal (38-mm actual) thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions and for load-bearing partitions where framing members bearing on partition are located directly over studs. Fasten plates to supporting construction unless otherwise indicated.
- B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.
- C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
  1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal (89-mm actual) depth for openings 48 inches (1200 mm) and less in width, 6-inch nominal (140-mm actual) depth for openings 48 to 72 inches (1200 to 1800 mm) in width, 8-inch nominal (184-mm actual) depth for openings 72 to 120 inches (1800 to 3000 mm) in width, and not less than 10-inch nominal (235-mm actual) depth for openings 10 to 12 feet (3 to 3.6 m) in width.
  2. For load-bearing walls, provide double-jamb studs for openings 60 inches (1500 mm) and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated on the Drawings.
- D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal- (19-by-89-mm actual-) size boards, let-in flush with faces of studs.

### **3.5 CEILING JOIST AND RAFTER FRAMING INSTALLATION**

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
  - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.
- D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

### **3.6 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 rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 1000**

**SECTION 06 1600  
SHEATHING**

**PART 1 - GENERAL**

**1.1 RELATED REQUIREMENTS**

- A. Section 06 1000 – Rough Carpentry

**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.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies 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 plywood complies with requirements. Include physical properties of treated materials.
  - 3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
  - 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.
  - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For following products, from ICC-ES:
  - 1. Preservative-treated plywood.
  - 2. Fire-retardant-treated plywood.

**1.4 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.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**PART 2 - PRODUCTS**

**2.1 WALL AND SOFFIT SHEATHING**

- A. Plywood Wall Sheathing: Exterior, Structural I sheathing.
  - 1. Span Rating: Provide span rating consistent with framing member spacing shown on the Drawings.
  - 2. Nominal Thickness: Not less than ½ inch.

**2.2 ROOF SHEATHING**

- A. Exterior, Structural I sheathing.
- B. Span Rating: Provide span rating consistent with framing member spacing shown on the Drawings.
- C. Nominal Thickness: Not less than ¾ inch.

### **2.3 FASTENERS**

- A. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
- B. Coordinate wall sheathing installation with flashing and joint-sealant installation to prevent exterior moisture from passing through completed assembly.
- C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- D. 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 WOOD STRUCTURAL PANEL INSTALLATION**

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

**END OF SECTION**

**SECTION 06 1715  
ENGINEERED STRUCTURAL WOOD**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural composite lumber.
  - 2. Prefabricated wood I-joists.
- B. 3. Engineered rim boards.  
Related Requirements:
  - 1. Section 06 1000 "Rough Carpentry" for dimension lumber items associated with engineered structural wood.
  - 2. Section 06 1753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include data on adhesives, fabrication, and protection.
  - 2. For preservative-treated wood products, include manufacturer's written instructions for handling, storing, installing, and finishing treated material.
  - 3. For connectors, include installation instructions.
- B. Shop Drawings:
  - 1. Identify metal connectors (joist, beam, post cap, anchors, etc.) by manufacturer and model number. Include a list of accessories required for installation at each connector (blocking, squash blocks, stiffeners, fasteners, etc.). Include allowable design loads for selected metal connectors in design calculation analysis.
  - 2. Identify manufacturer's recommended installation details in layouts.
  - 3. Provide documentation that allowable design stresses comply with allowable design properties of each product indicated.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- B. Research Reports: For engineered structural wood, from ICC-ES or recognized third-party testing laboratory.

**1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in ASTM D5055 or ASTM D5456, and involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.
- B. 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.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store, stack, and handle engineered wood products to comply with recommendations of APA EWS E705.
  - 1. Store wrapped or banded together until ready for installation, on level well-drained area. Do not store in direct contact with the ground. Use stickers to separate bundles, spaced as recommended in writing by manufacturer.
  - 2. Store I-joists level with the webs vertically.
- B. Do not stack other material on top of structural composite lumber or I-joists.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain each type of engineered wood product from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
  - 1. Allowable design stresses, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

### **2.3 STRUCTURAL COMPOSITE LUMBER**

- A. Laminated-Veneer Lumber (LVL): Preservative-treated, structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
  - 1. Allowable Stresses:
    - a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2900 psi for 12-inch nominal-depth members.
    - b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi.
- B. Parallel-Strand Lumber (PSL): Preservative-treated, structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
  - 1. Allowable Stresses:
    - a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2900 psi for 12-inch nominal-depth members.
    - b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi.
- C. Laminated-Strand Lumber (LSL): Preservative-treated, structural composite lumber made from wood flake strands with grain primarily parallel to member lengths, evaluated and monitored in accordance with ASTM D5456, and manufactured with exterior-type adhesive complying with ASTM D2559.
  - 1. Allowable Stresses:
    - a. Extreme Fiber Stress in Bending, Edgewise (Fb): 2900 psi for 12-inch nominal-depth members.
    - b. Modulus of Elasticity, Edgewise (E): 2,000,000 psi.

### **2.4 PREFABRICATED WOOD I-JOISTS**

- A. Prefabricated Units: I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural webs, let into and bonded to flanges. Comply with material requirements of, and with structural capacities established and monitored in accordance with, ASTM D5055.
  - 1. Flange Material: Laminated-veneer or machine stress-rated (MSR) lumber.
  - 2. Web Material: OSB, Exposure 1.
  - 3. Structural Properties: Depths and design values not less than those indicated.
  - 4. Identification Marks:
    - a. Factory mark I-joists with manufacturer's name, joist series, mill identification, manufacturing date and time, name of third-party inspection agency, and ICC/CCMC code report number. Repeat identification marks at minimum 12 ft. intervals.

## **2.5 ENGINEERED RIM BOARDS**

- A. Prefabricated, structural panel complying with APA PRR 410, APA PRR 401, or ASTM D7672 for wood frame construction and research or evaluation report for I-joists.
  - 1. Manufacturer: Provide products by same manufacturer as I-joists.
  - 2. Material: OSB or LVL.
  - 3. Thickness: 1 inch.
  - 4. Identification Marks: Comply with APA PRR-401, rim board grade.
    - a. Factory mark rim boards with manufacturer's name, rim board series, mill identification, manufacturing date and time, name of third-party inspection agency, and ICC/CCMC code report number. Repeat identification marks at minimum 12 ft. intervals.

## **2.6 PRESERVATIVE TREATMENT**

- A. Description: Preservative treatment; AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3B for exterior construction not in contact with ground, and Use Category UC4A for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

## **2.7 FASTENERS**

- A. General: Fasteners are to be of size and type indicated and to comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
- 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. Wood Screws and Lag Screws: ASME B18.2.1, ASME B18.6.1, or ICC-ES AC233.
- E. Carbon Steel Bolts: ASTM A307 with ASTM A563 hex nuts and, where indicated, flat washers all hot-dip zinc coated.
- F. Stainless Steel Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.
- G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.

## **2.8 METAL FRAMING ANCHORS**

- A. Allowable design loads, as published by manufacturer, are to meet or exceed those indicated. Manufacturer's published values are to be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by qualified independent testing agency. Framing anchors are to be punched for fasteners adequate to withstand same loads as framing anchors.
- B. I-Joist Hangers: U-shaped joist hangers with seat and nailing flanges, full depth of joist, as indicated on Drawings. Nailing flanges provide lateral support at joist top chord.
  - 1. Thickness: 0.040 inch.
  - 2. Finish: Galvanized.
- C. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
  - 1. Strap Width: 1-1/2 inches.
  - 2. Thickness: 0.050 inch.
- D. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch-minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
- E. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.
  - 1. Width: 3/4 inch.
  - 2. Thickness: 0.050 inch.
  - 3. Length: 24 inches or as indicated.



- F. Materials: Unless otherwise indicated, fabricate from the following materials:
1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
    - a. Use for interior locations unless otherwise indicated.
  2. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
    - a. Use for wood-preservative-treated lumber and where indicated.
  3. Stainless steel bars and shapes complying with ASTM A276/A276M, Type 304.
    - a. Use for exterior locations and where 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.
  1. Verify that joist flange widths match hanger widths.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Do not install in direct contact with concrete or masonry.
- B. Where wood-preservative-treated members are installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  1. Use treatment approved in writing by manufacturer.

### **3.3 INSTALLATION OF STRUCTURAL COMPOSITE LUMBER**

- A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.
  1. Install in dry, covered conditions where average in-service moisture content of lumber is 16 percent or less.
  2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.
    - a. Connections based on NDS or manufacturer's test or code reports.
  3. Install lumber plumb and level. Accurately fit, align, securely fasten, and install free from distortion or defects.
  4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
- B. Cutting: Confirm size and location of field cutting, notching, and drilling with ESR report, registered design professional, and manufacturer.

### **3.4 INSTALLATION OF PREFABRICATED WOOD I-JOISTS**

- A. Install to comply with ESR report, manufacturer's written instructions, and applicable code.
  1. Install in dry, covered conditions where in-service moisture content of wood does not exceed 16 percent.
  2. Install metal framing connections in accordance with AWC's "National Design Specification (NDS) for Wood Construction." Install fasteners through each fastener hole.
  3. Install joists with top and bottom flanges within 1/2 inch of true vertical alignment, and support ends of each member with not less than 1-3/4 inches for end bearing and 3-1/2 inches for intermediate bearings.
  4. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  5. Provide lateral restraint at supports to prevent rotation, and along the compression flange of each joist.
  6. Completely install and properly nail hangers, rim joists, rim boards, blocking panels, and x-bracing as each joist is set.

- B. Cantilevered portions of joists must not exceed a maximum length equal to one-third the adjacent span, and support only uniform loads, unless designed by a design professional and approved by authorities having jurisdiction.
  - 1. Temporarily secure ends of cantilevers with strut lines on both top and bottom flanges. Remove only as required to install permanent sheathing.
- C. Cutting: Do not splice structural members between supports unless otherwise indicated.
  - 1. Do not cut, drill, or notch I-joist top and bottom flanges except for cutting to length.

### **3.5 INSTALLATION OF ENGINEERED RIM BOARDS**

- A. Install at bearing walls perpendicular to and supported by I-joists that require full-depth blocking, or rim joists, at supports.
- B. Sill Sealer Gasket: Install to form continuous seal between sill plates and foundation walls.

### **3.6 PROTECTION**

- A. Protect wood that has been treated with SBX from weather. If, despite protection, SBX-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 1715**

**SECTION 06 1753  
SHOP FABRICATED WOOD TRUSSES**

**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. Wood Floor Trusses
  - 2. Wood roof trusses.
  - 3. Wood girder trusses.
  - 4. Wood truss bracing.
  - 5. Metal truss accessories.

**1.3 RELATED SECTIONS**

- A. Section 06 0500 - Common work Results for Wood, Plastic, and Composites

**1.4 DEFINITIONS**

- A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

**1.5 ACTION SUBMITTALS**

- A. Shop Drawings: Show fabrication and installation details for trusses.
  - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
  - 2. Indicate sizes, stress grades, and species of lumber.
  - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
  - 6. Show splice details and bearing details.
- B. Delegated-Design Submittal: For metal-plate-connected wood trusses 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. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.
- B. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss fabricating firm.

**1.7 QUALITY ASSURANCE**

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
  - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an

independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
  - 1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
  - 2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
  - 3. Provide for air circulation around stacks and under coverings.
- B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions specified in Structural Notes on the Drawings. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
  - 1. Design Loads: As indicated.
- C. Comply with applicable requirements and recommendations of the following publications:
  - 1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
  - 2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
  - 3. TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."
- D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

### **2.2 DIMENSION LUMBER**

- A. Certified Wood: For metal-plate-connected wood trusses and permanent bracing, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- B. 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. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
  - 3. Provide dressed lumber, S4S.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.
- C. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal (38 by 140 mm actual) for both top and bottom chords.
- D. Minimum Specific Gravity for Top Chords: 0.50.
- E. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 06 1000 "Rough Carpentry."

### **2.3 METAL CONNECTOR PLATES**

- A. Source Limitations: Obtain metal connector plates from single manufacturer.
- B. General: Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 (Z180) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for interior locations unless otherwise indicated.

## **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. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F 1667.

## **2.5 METAL FRAMING ANCHORS AND ACCESSORIES**

- A. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  1. Use for interior locations unless otherwise indicated.
- C. Roof Truss Clips: Angle clips for bracing bottom chord of roof trusses at non-load-bearing walls, 1-1/4 inches (32 mm) wide by 0.050 inch (1.3 mm) thick. Clip is fastened to truss through slotted holes to allow for truss deflection.

## **2.6 MISCELLANEOUS MATERIALS**

- A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

## **2.7 FABRICATION**

- A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.
- B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.
- C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
  1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## **2.8 SOURCE QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform special inspections.
  1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
  2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.
- B. Correct deficiencies in Work that special inspections indicate does not comply with the Contract Documents.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.
- C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

- D. Install and brace trusses according to TPI recommendations and as indicated.
- E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.
- F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.
- G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- H. Securely connect each truss ply required for forming built-up girder trusses.
  - 1. Anchor trusses to girder trusses as indicated.
- I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing to comply with Section 06 1000 "Rough Carpentry." Retain subparagraph below if floor trusses are required.
  - 2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.
- J. Install wood trusses within installation tolerances in TPI 1.
- K. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- L. Replace wood trusses that are damaged or do not meet requirements.
  - 1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Architect.

### **3.2 REPAIRS AND 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 wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- C. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- D. Protective Coating: Clean and prepare exposed surfaces of metal connector plates. Brush apply primer, when part of coating system, and one coat of protective coating.
  - 1. Apply materials to provide minimum dry film thickness recommended by coating system manufacturer.

**END OF SECTION 06 1753**

**SECTION 06 2000  
FINISH CARPENTRY**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Composite wood casings and moldings.
- B. Cellular PVC window sills.

**1.2 RELATED REQUIREMENTS**

- A. Section 06 0500 - Basic Materials and Methods: Wood and Plastics
- B. Section 09 9000 - Painting and Coating: Painting and finishing of finish carpentry items.

**1.3 REFERENCE STANDARDS**

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; current edition.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; current edition.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Samples: Two samples of each trim profile required with specified finish applied.

**1.5 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Protect work from moisture damage.

**PART 2 - PRODUCTS**

**2.1 FINISH CARPENTRY ITEMS**

- A. Quality Grade: Unless otherwise indicated provide products of quality specified by AWI/AWMAC/WI Architectural Woodwork Standards for Premium Grade.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
  - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear white pine; prepare for paint finish.

**2.2 MATERIALS**

- A. Wood-Plastic Composite: Cellulosic fiber and polypropylene composite lumber. Fabricate in casing and molding patterns indicated. Submit samples for verification.

**2.3 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.

- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch (1 mm). Do not use additional overlay trim to conceal larger gaps.

### **3.2 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 09 9000.

### **3.3 TOLERANCES**

- A. Maximum Variation from True Position: 1/16 inch (1.5 mm).
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch (0.7 mm).

**END OF SECTION 06 2000**



**SECTION 06 4023  
INTERIOR ARCHITECTURAL WOODWORK**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Plastic-laminate cabinets and casework and tops for common building areas.
- B. Cultured marble bathroom sinks, counters and splashes
- C. Closet shelving

**1.2 RELATED SECTIONS**

- A. 06 1000 - Rough Carpentry for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
- B. 06 2000 - Finish Carpentry for interior standing and running trim.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated, including cabinet hardware and accessories and finishing materials and processes.
  - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, and other items installed in architectural woodwork.
  - 3. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with 1 sample applied to core material and specified edge material applied to 1 edge.
  - 4. Exposed cabinet hardware and accessories, one unit for each type and finish.

**1.4 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork with sequence-matched wood veneers.
- C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- D. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## 1.7 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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.
- B. Wood Products: Comply with the following:
  - 1. Hardboard: AHA A135.4.
  - 2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
  - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
- C. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
  - 1. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semiexposed edges.
- D. High-Pressure Decorative Laminate (Plastic Laminate): NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
  - 1. Basis of Design: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
    - a. Formica Corporation.
    - b. Nevamar Company, LLC; Decorative Products Div.
    - c. Wilsonart International; Div. of Premark International, Inc.
- E. Cultured Marble Bathroom Sink and Surround: ICPA/NAHB certified to comply with ANSI Z124.3, Type 5 for cultured marble vanity tops with integral bowl, and molded backsplash.
  - 1. Cast polyester resin, calcium carbonate, catalyst, lightweight filler and selected pigments.
  - 2. Gelcoat: Neophenyl Glycol (N.P.G.) Isophthalic, 20 mils thick at water impingement areas, 15 mils in other areas. U.V. stabilized.
  - 3. Catalyst: Methyl Ethyl Ketone Peroxide with residual Hydrogen Peroxide content of less than 1%.
  - 4. Polyester Resin: Minimum 65% solids, with specific gravity of 1.12 or higher.
  - 5. Calcium Carbonate shall have specific gravity of 2.7 or greater and hardness (Mho's Scale) of 3 or greater.
  - 6. Light weight Filler: Thermolite or compatible, with a minimum of 7% filler.
  - 7. Color: Selected by Architect.

### 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements Section 06 0500.
- B. Fire-Retardant Particleboard: Panels complying with the following requirements, made from softwood particles and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 25 or less per ASTM E 84.
  - 1. For panels 3/4 inch thick and less, comply with ANSI A208.1 for Grade M-2 except for the following minimum properties: modulus of rupture, 1600 psi; modulus of elasticity, 300,000 psi; internal bond, 80 psi; and screw-holding capacity on face and edge, 250 and 225 lbf, respectively.

2. For panels 13/16 to 1-1/4 inches thick, comply with ANSI A208.1 for Grade M-1 except for the following minimum properties: modulus of rupture, 1300 psi; modulus of elasticity, 250,000 psi; linear expansion, 0.50 percent; and screw-holding capacity on face and edge, 250 and 175 lbf, respectively.
  3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Weyerhaeuser.
- C. Fire-Retardant Fiberboard: Medium-density fiberboard panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.
1. Product: Subject to compliance with requirements, provide "Medite FR" by SierraPine Ltd.; Medite Div.

### 2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Butt Hinges: 2-3/4-inch, 5-knuckle steel hinges made from 0.095-inch-thick metal, self-closing, and as follows:
1. Semiconcealed, Self-Closing Hinges for Overlay Doors: BHMA A156.9, B01521.
  2. Manufacturer/Product: Rockford Process Control, No. 376 or product that complies with requirements by the following manufacturer:
    - a. Amerock.
    - b. Liberty Hardware.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 120 degrees of opening, self-closing.
1. Manufacturer/Product: BLUM No. 73T5580 or product that complies with requirements by the following manufacturer:
    - a. Grass America.
- D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.
1. Manufacturer/Product: Rockford Process Control Wire Pull No. P604 or product that complies with requirements by the following manufacturer:
    - a. Doug Mockett and Co., Inc.
- E. Catches: Magnetic catches, BHMA A156.9, B03141.
1. Provide one catch for each door.
- F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
1. Manufacturer/Product: Knape Vogt No. 255ZC pilaster standard recessed flush with No. 239 ZC support.
- G. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.
- H. Drawer Slides: BHMA A156.9, B05091.
1. Unless noted otherwise, drawer slides are Heavy Duty (Grade 1HD-100 and Grade 2HD-200): Side mounted; full extension type; zinc-plated steel ball-bearing slides.
  2. Basis of Design: Subject to compliance with requirements. Provide Knape and Vogt (KV) products listed or comparable products by the following:
    - a. Accuride.
- I. Door Locks: BHMA A156.11, E07121.
- J. Drawer Locks: BHMA A156.11, E07041.
- K. Push-Button Locks: Where indicated on the Drawings, provide push button cabinet locks equivalent to Simplex 900 Series Deadbolt lock.
- L. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Satin Stainless Steel: BHMA 630.
- M. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.
- B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- D. Silicone Sealant for Solid Surfaces: Mildew-resistant, FDA-compliant sealant recommended by solid surface material manufacturer, in color to match solid surface.

## 2.5 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
- D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
  - 1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
  - 2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
  - 3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.
- 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 various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.
  - 2. Provide cutout and install grommets as directed by Owner.

## 2.6 PLASTIC-LAMINATE CABINETS

- A. Grade: Custom.
- B. AWI Type of Cabinet Construction: Flush overlay.
- C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
  - 1. Horizontal Surfaces Other Than Tops: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade VGS.
  - 4. Edges: PVC edge banding, 0.12 inch thick, in color, pattern, and finish selected by the Architect.
- D. Materials for Semiexposed Surfaces:
  - 1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

- b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, Grade CLS.
- 2. Drawer Sides and Backs: Thermoset decorative panels.
- 3. Drawer Bottoms: Thermoset decorative panels.
- E. Concealed Backs of Panels with Exposed Plastic Laminate Surfaces: High-pressure decorative laminate, Grade BKL.
- F. Colors, Patterns, and Finishes: As selected by the Architect and confirmed by samples properly submitted for verification.

## **2.7 PLASTIC-LAMINATE COUNTERTOPS**

- A. See specification section 12 3600 Countertops.

## **2.8 CLOSET AND UTILITY SHELVING**

- A. Grade: Custom.
- B. Shelf Material: 3/4-inch thermoset decorative panel with PVC or polyester edge banding.
- C. Cleats: 3/4-inch solid lumber panel product.
- D. Wood Species: Any closed-grain hardwood.
- E. Adjustable shelf standards and brackets:
  - 1. Knap & Vogt No. 87 heavy duty standard with No. 187 bracket for 12 inch deep shelves, anachrome finish steel.
- F. Coat Rod: Knap & Vogt 750 1 rod (length as required) w/Knap & Vogt 734 CHR flanges.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### **3.2 INSTALLATION**

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Window Stools: Install single full-length pieces (from maximum length of lumber available) with no joints.
- H. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

- a. Use countersunk washers with fasteners.
- I. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  - 1. Align adjacent countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
  - 2. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 3. Secure backsplashes to walls with adhesive.
  - 4. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."
- J. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- K. Refer to Division 09 Sections for final finishing of installed architectural woodwork not indicated to be shop finished.

### **3.3 ADJUSTING AND CLEANING**

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

**END OF SECTION 06 4023**

**SECTION 06 6640  
DECORATIVE COLUMNS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fiberglass columns for exterior use.

**1.2 SUBMITTALS**

- A. Product Data: Provide Manufacturer's Data for each product to be used, including: storage and handling requirements and recommendations; preparation instructions and recommendations and installation methods.
- B. Shop drawings: Submit detailed drawings showing location, profiles and product components, including but not limited to anchorage requirements, accessories and provisions for achieving desired finishes.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: Installer shall have a minimum of 5 years experience installing products of similar type and scope as those specified in this section.

**1.4 DELIVERY, STORAGE AND HANDLING**

- A. Deliver materials in original packaging, unopened with no visible damage.
- B. Store and protect materials in accordance with manufacturer's requirements for environmental and physical protection. Keep temporary protective coverings in place.
- C. Protect materials and finish from damage during handling and installation.

**1.5 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 recommendations.
- B. Field Measurements: Verify actual measurements and openings by field measurements before fabrication. Show recorded measurements or shop drawings.
- C. Allow at least 24 hours for materials to adapt to conditions at project site prior to installation.

**1.6 WARRANTY**

- A. Upon completion of work, provide a written Manufacturer's Lifetime Limited Warranty for products installed as part of this project to the Original Owner.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis of Design Manufacturer:
  - Edon Corporation
- B. Other acceptable manufacturers:
  - 1. Arndt & Herman.
  - 2. Melton Classics.

**2.2 MATERIALS**

- A. Decorative Columns: Square, non-tapered, smooth, in dimensions indicated on the Drawings. Contractor shall review existing conditions and perform field measuring to assure proper fit.
- B. Column Caps and Bases: Material, diameter, and type for specified columns.

**2.3 MOLDS**

- A. Molds shall be constructed of from 10-12 layers of glass fibers with tooling gel-coat and/or rubber molds.

## 2.4 FIBERGLASS AND RESIN MATERIALS

- A. General: The fiberglass reinforced polyester plastic components shall be designed, fabricated and erected to conform to the state of Building Code, Local Codes and to the Architect's design criteria.
- B. Glass cloth, matt and "chop" shall be equal to the products of PPG-Owens Corning.
- C. Polyester resins shall be Class A flame-retardant, promoted thixotropic polyester resin designed for use in hand lay-up and spray-up processes. The resin shall be specifically formulated for use in applications that require an ASTM E-84, Class 1 flame spread rating, without the use of fillers or antimony trioxide, with an ASTM E-84 flame spread rating of less than 25 unfilled and smoke density under 450.
- D. Gel Coat: The gel coat shall be a high-performance product with ultraviolet inhibitors as recommended by the gel coat and fiberglass panel manufacturer. Acceptable products are:
  - 1. LHM2900 Low Hap HydroShield Lite NPG ISO Marine Gelcoat by HK Research, 908 Lenoir Road, Hickory, NC 28603, (800) 334-5975
  - 2. "951-Armorcote IMC" by Cook Composites and Polymers Co., P. O. Box 419389, Kansas City, MO 64141-6389, (816) 391-6000.
  - 3. "Max-Guard" Series by Ashland Inc., 2 Joy Drive, Budd Lake, NJ 07828, (908) 850-3046
  - 4. "Ultra Shield-NPG" by Ferro Corporation, 6060 Parkland Blvd., Mayfield Heights, OH 44124 (216) 875-5600
- E. Gel coat thickness shall be 0.015" minimum to 0.025" maximum.

## 2.5 FABRICATION

- A. Fiberglass reinforced polyester components shall be manufactured using the specified resins, reinforced with the chopped glass fibers. All exposed surfaces shall be finished with colored gel-coat with UV inhibitor.
- B. Internal metal reinforcement, anchorage clips, brackets and all other "built-in" accessories shall be captured and additionally reinforced with additional glass fiber and mat of sufficient thickness per the manufacturers design.
- C. Final ratio of materials shall be 25% fiber, 75% resin for body of components.
- D. All metal hardware, both loose and embedded, shall be stainless steel or aluminum as designed by manufacturer. All fasteners to be stainless steel.
- F. Component thickness shall be 1/8- 3/16" minimum.
- G. Gel-coated thickness shall be .015" to .025".
- H. Finished components shall be true to line in the shapes indicated on the drawings, free of warps, twists, waves or distortion.
- I. Joints in components shall be matched at the factory and numbered for field installation. Components shall be fabricated to minimize exposed fasteners.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Ensure full compliance with Manufacturer's instructions in all aspects of tasks required by this work. Install products in accordance with manufacturer's instructions at locations indicated on the drawings.
- B. Coordinate all work with other project trades to assure proper installation and provide proper accommodations for following work by other trades.

### 3.2 FIELD QUALITY CONTROL

- A. After installation, check all work for flaws and defects.
- B. Repair all defective work.
- C. Remove and replace all damaged components that cannot be successfully repaired as determined by Architect.



**3.3 PROTECTION**

- A. Install temporary protective materials necessary to prevent damage to materials installed in this work until final acceptance of the project.

**3.4 CLEANING**

- A. Remove all protection materials.
- B. Clean all surfaces following manufacturer's recommendations prior to final project completion. Do not use harsh cleaning materials or methods that would damage finish.
- C. Dispose properly of all debris generated by this work, protection materials and cleaning materials.

**END OF SECTION 06 6640**

**SECTION 07 0500  
COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes basic requirements for subsequent Division 07 Specification Sections.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. Sustainable Design Submittals: Refer to Section 01 8113 – Sustainable Design Requirements for the following:
  - 1. Recycled content
  - 2. Regional materials.
- B. VOC Content of Sealants: Refer to Section 01 6116 – Volatile Organic Content Restrictions and as follows:
  - 1. Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
    - a. Architectural Sealants: 250 g/L.
    - b. Sealant Primers for Nonporous Substrates: 250 g/L.
    - c. Sealant Primers for Porous Substrates: 775 g/L.
- C. Construction Waste Management: Comply with requirements of Section 01 7419 – Construction Waste Management and Disposal.

**1.4 REFERENCES**

- A. General: Section 01 4200 – Reference Standards.

**1.5 SUBMITTALS**

- A. General: Section 01 3000 – Administrative Requirements: For submittal requirements.

**1.6 QUALITY ASSURANCE**

- A. General: Section 01 4000 – Quality Requirements.
- B. Installer Qualifications: Engage only qualified installers to perform work. Refer to subsequent Division 07 Sections for more specific requirements.
- C. Regulatory Requirements: Comply with requirements of authorities having jurisdiction related to the following:
  - 1. Fire and wind resistance of products and assemblies.
- D. Source Limitation: Obtain each type of specified product from a single qualified manufacturer and distribution source.
- E. Pre-Construction Conferences. Conduct pre-construction conferences for coordinating trade contractors whose work will interface with or be affected by work in this Division.

**1.7 COORDINATION**

- A. Provide openings for equipment and accessories that will be installed by other trades. When indicated on the Drawings, provide supplementary structural reinforcement at openings to accommodate imposed loads.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's delivery, storage, and handling information.
- B. Establish proper storage conditions at shops, the site, and other points of delivery to prevent loss, deterioration, damage, and theft.

1. Provide temporary heat and humidity control if required to achieve the conditions required by referenced standards.
  2. Store products in accordance with referenced standards to prevent puncture, detrimental exposure to sunlight and inclement weather, condensation, and other incidental damage at the site.
- C. Inspect and inventory products upon delivery. Reject defective or damaged products and promptly remove them from the Site.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS, GENERAL**

- A. Refer to Section 01 6000 – Product Requirements.

## **PART 3 EXECUTION**

### **3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution Requirements.

### **3.2 INSPECTION**

- A. Verify acceptability of substrate conditions in accordance with referenced standards and manufacturer's instructions. Correct non-complying conditions, including removal of interfering elements, restoration of substrates, and installation of supplementary framing, blocking, and supports. Do not proceed with installation until conditions are correct in accordance with referenced standards and product installation requirements.

### **3.3 PREPARATION**

- A. Isolate components to prevent contact with incompatible substrates, including dissimilar metals to prevent galvanic reaction.
- B. Flash openings to prevent the intrusion of water into the building.

### **3.4 INSTALLATION**

- A. Install products in accordance with the drawings, manufacturer's recommendations, and approved shop drawings to result in weathertight installations.

**END OF SECTION 07 0500**

**SECTION 07 2100  
THERMAL AND ACOUSTICAL INSULATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Batt insulation for filling perimeter window and door shim spaces.
- B. Rigid board insulation for concrete slab construction.
- C. Sound batt insulation in the stud cavities of walls.
- D. Blown in insulation.

**1.2 RELATED REQUIREMENTS**

- A. Section 07 0500 – Common Work Results for Thermal and Moisture Protection

**1.3 REFERENCE STANDARDS**

- A. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; current edition.
- B. ASTM C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; current edition.
- C. ASTM D 2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; current edition.
- D. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

**1.5 FIELD CONDITIONS**

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. 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. CertainTeed Corporation.
  - 2. Guardian Building Products, Inc.
  - 3. Johns Manville.
  - 4. Knauf Insulation.
  - 5. Owens Corning.
  - 6. Thermo fiber

**2.2 APPLICATIONS**

- A. Insulation Under Concrete Slabs: Extruded polystyrene board.
- B. Insulation in Interior Walls: Sound batt insulation

**2.3 RIGID BOARD INSULATION MATERIALS**

- A. Extruded Polystyrene Board Insulation: ASTM C 578, Type X; Extruded polystyrene board with either natural skin or cut cell surfaces; with the following characteristics:
  - 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E 84.
  - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E 84.
  - 3. Board Size: 48 x 96 inch.
  - 4. Board Thickness: 2 inches.
  - 5. Board Edges: Square.
  - 6. Thermal Conductivity (k factor) at 25 degrees F: 0.18.

7. R-Value: 5 per inch
8. Compressive Resistance: 15 psi.
9. Board Density: 1.3 lb/cu ft.
10. Water Absorption, maximum: 0.3 percent, volume.

## **2.4 BATT INSULATION MATERIALS**

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Mineral Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C 665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E 84.
  1. Where indicated, provide foil facing on one side; with flame spread index of 25 or less, when tested in accordance with ASTM E 84.
  2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E 84.
  3. R-Value: 19.
  4. Thickness: 4-6 inches, fill stud cavity

## **2.5 SEMI-RIGID BATT (ACOUSTICAL) INSULATION**

- A. R-Value: 3.7 per inch.
- B. Facing: Unfaced only.
- C. Density: 4.0 pcf (nominal) for 1" thick material.
- D. Density: 2.5 pcf (nominal) for thicknesses greater than 1".
- E. Surface Burning Characteristics: Unfaced- Flame Spread 0 and Smoke Developed 0.
- F. Minimum Recycle Content: 70% (Pre-Consumer).
- G. Thickness: Fill stud cavities

## **2.6 BLOWN INSULATION**

- A. Compliances: ASTM C764, Type I CAN/ULC-S102.2 and ASTM E84
- B. Fire performance: Flame Spread 25 or less, Smoke Developed 50 or less
- C. Assembly R-Value: 38.

## **2.7 ACCESSORIES**

- A. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- B. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
- C. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, or irregularities.

### **3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER**

- A. Apply adhesive to back of boards:
  1. Full bed 1/8 inch thick.
- B. Install boards vertically on foundation perimeter.
  1. Place boards to maximize adhesive contact.
  2. Install in running bond pattern.
  3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

### **3.3 BOARD INSTALLATION UNDER CONCRETE SLABS**

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

### **3.4 BATT INSTALLATION**

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Install in interior walls where indicated on the drawings. Do not compress insulation, fill cavity full.
- D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- E. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- F. Install with factory applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- G. Staple or nail facing flanges in place at maximum 6 inches on center.
- H. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- I. At wood framing, place vapor retarder on warm side of insulation by stapling at 6 inches on center. Lap and seal sheet retarder joints over member face.
- J. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over member face.
- K. Tape seal tears or cuts in vapor retarder.
- L. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

### **3.5 BLOWN INSULATION**

- A. Apply blown insulation according to the approved manufacturer's instructions with manufacturer-approved equipment.

### **3.6 PROTECTION**

- A. Do not permit installed insulation to be damaged prior to its concealment.

**END OF SECTION 07 2100**

**SECTION 07 2500  
WEATHER BARRIERS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Water-resistive sheet materials
- B. Sheet weather barriers
- C. Self-adhesive flexible flashing

**1.2 RELATED REQUIREMENTS**

- A. Section 07 0500 - Common Work Results for Thermal and Moisture Protection

**1.3 REFERENCE STANDARDS**

- A. AATCC Test Method 127 - Water Resistance: Hydrostatic Pressure Test; current edition.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; current edition.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Provide data on material characteristics.
- B. Manufacturer's Installation Instructions: Indicate preparation.

**1.5 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

**PART 2 - PRODUCTS**

**2.1 WATER-RESISTIVE SHEET MATERIALS**

- A. Asphalt Felt: ASTM D226 Type I felt (No.15).

**2.2 SHEET WEATHER BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)**

- A. Weather Barrier Sheet:
  - 1. Water Penetration Resistance: Withstand a water head of 21 inches (55 cm), minimum, for minimum of 5 hours, when tested in accordance with AATCC 127.
  - 2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
  - 3. Products:
    - a. DuPont Company; Tyvek CommercialWrap: [www.dupont.com](http://www.dupont.com).
    - b. Fiberweb, Inc; Typar MetroWrap: [www.typar.com](http://www.typar.com).
    - c. Pactiv Corporation; GreenGuard C2000 Building Wrap: [greenguard.pactiv.com](http://greenguard.pactiv.com).
    - d. VaproShield, LLC; WrapShield: [www.vaproshield.com](http://www.vaproshield.com).

**2.3 SELF-ADHESIVE FLEXIBLE SHEET FLASHING**

- A. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970, except slip resistance requirement is waived if not installed on a roof.
  - 1. Composition: Modified bituminous sheet laminated to polyethylene sheet.
  - 2. Thickness: 25 mil (0.64 mm), nominal.
  - 3. Products:
    - a. Grace VYCOR Plus Self-Adhered Flashing.

**2.4 ACCESSORIES**

- A. Thinners and Cleaners: As recommended by material manufacturer.
- B. Adhesives and Sealants: As recommended by the primary material manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### **3.2 PREPARATION**

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

### **3.3 INSTALLATION**

- A. Install materials in accordance with manufacturer's instructions.
- B. Sheet Weather Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces. Fasten sheets as follows:
- C. Attach to framed construction with fasteners extending through sheathing into framing. Space fasteners at 12 to 18 inches (305 to 460 mm) on center along each framing member supporting sheathing.
- D. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
- E. Where stud framing rests on concrete or masonry, extend lower edge of sheet at least 4 inches (100 mm) below bottom of framing and seal to foundation with sealant.
- F. Install over jamb flashings.
- G. Self-Adhesive Sheet Flashing:
  - 1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.
  - 2. Lap sheets shingle-fashion to shed water and seal laps air tight.
  - 3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that all laps are firmly adhered with no gaps or fishmouths.
  - 4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.
  - 5. At wide joints, provide extra flexible membrane allowing joint movement.
  - 6. At window and door penetrations, install according to manufacturer's Severe Exposure installation method.
- H. Openings and Penetrations:
  - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.
  - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches (100 mm) wide; do not seal sill flange.
  - 3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.
  - 4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.
  - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
  - 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

### **3.4 FIELD QUALITY CONTROL**

- A. Do not cover installed weather barriers until required inspections have been completed.
- B. Obtain approval of installation procedures by the weather barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.



**3.5 PROTECTION**

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION 07 2500**

**SECTION 07 3113  
ASPHALT SHINGLES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Asphalt shingle roofing.
- B. Self-adhesive waterproofing membrane for eave protection and underlayment.
- C. Associated metal flashings and accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 07 0500 – Basic Materials and Methods - Thermal and Moisture Protection.
- B. Section 07 6200 - Sheet Metal Flashing and Trim

**1.3 REFERENCE STANDARDS**

- A. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; current edition.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; current edition.
- C. ASTM D3161 - Standard Test Method for Wind-Resistance of Asphalt Shingles (Fan-Induced Method); current edition.
- D. ASTM D3462 - Standard Specification for Asphalt Shingles Made From Glass Felt and Surfaced With Mineral Granules; current edition.
- E. NRCA MS104 - The NRCA Steep Roofing Manual; National Roofing Contractors Association; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- B. Samples: Submit two samples of each shingle color indicating color range and finish texture/pattern; for verifying color selection.
- C. Manufacturer's Instructions: Indicate installation criteria and procedures.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Shingles: 400 sq ft of each type and color.

**1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with the recommendations of NRCA Steep Roofing Manual.

**PART 2 - PRODUCTS**

**2.1 SHINGLES**

- A. Basis of Design: Owens Corning – TRU-Definition Duration –color selected by the Architect.
- B. Other Acceptable Manufacturers:
  - 1. Certainteed
  - 2. Timberline
  - 3. Tamko Building Products
- C. Description: Asphalt-coated glass felt, mineral granule surfaced, complying with ASTM D3462; UL 790, Class A fire resistance.
  - 1. Wind Resistance: Class F, when tested in accordance with ASTM D3161.
  - 2. Warranted Wind Speed: Not less than tested wind resistance.
  - 3. Warranty: 30 year.
  - 4. Algae Resistant.
  - 5. Self-sealing type.
  - 6. Style: Architectural Dimensional.

## **2.2 SHEET MATERIALS**

- A. Eave Protection Membrane: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970; 40 mil (1 mm) total thickness; with strippable treated release paper and polyethylene sheet top surface.
- B. Underlayment: Asphalt-saturated organic roofing felt, unperforated, complying with ASTM D226, Type I ("No.15").
- C. Flexible Flashing: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970; 40 mil (1 mm) total thickness; with strippable treated release paper and polyethylene sheet top surface.

## **2.3 ACCESSORIES**

- A. Nails: Standard round wire shingle type, of hot-dipped zinc coated steel, 12 gage, 0.105 inch (2.67 mm) shank diameter, 3/8 inch (9.5 mm) head diameter, of sufficient length to penetrate through roof sheathing or 3/4 inch (19 mm) into roof sheathing or decking.
- B. Ridge Vents: Plastic, extruded with vent openings that do not permit direct water or weather entry; flanged to receive shingles; PV1448/PV2248 manufactured by Provent.
- C. Staples are not permitted.

## **2.4 METAL FLASHINGS**

- A. Metal Flashings: Provide sheet metal eave edge, gable edge, ridge, ridge vents, chimney flashing, and other flashing indicated.
  - 1. Form sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
  - 2. Hem exposed edges of flashings minimum 1/4 inch (6 mm) on underside.
- B. Sheet Metal: Prefinished aluminum, as specified in Section 07 6200.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions prior to beginning work.
- B. Verify that deck is of sufficient thickness to accept fasteners.
- C. Verify that roof penetrations and plumbing stacks are in place and flashed to deck surface.
- D. Verify roof openings are correctly framed.
- E. Verify deck surfaces are dry, free of ridges, warps, or voids.

### **3.2 PREPARATION**

- A. At areas where eave protection membrane is to be adhered to substrate, fill knot holes and surface cracks with latex filler.
- B. Broom clean deck surfaces before installing underlayment or eave protection.
- C. Install eave edge and gable edge flashings tight with fascia boards. Weather lap joints 2 inches (50 mm) and seal with plastic cement. Secure flange with nails spaced 16 inches on center.

### **3.3 INSTALLATION - EAVE PROTECTION MEMBRANE**

- A. Install eave protection membrane from eave edge to minimum 3 ft up-slope beyond interior face of exterior wall.
- B. Install eave protection membrane in accordance with manufacturer's instructions.

### **3.4 INSTALLATION - UNDERLAYMENT**

- A. At Roof Slopes Greater Than 4:12 (1:3): Install underlayment perpendicular to slope of roof, with ends and edges weather lapped minimum 4 inches (100 mm). Stagger end laps of each consecutive layer. Nail in place. Weather lap minimum 4 inches (100 mm) over eave protection.
- B. Items projecting through or mounted on roof: Weather lap and seal watertight with plastic cement.

### **3.5 INSTALLATION - METAL FLASHING AND ACCESSORIES**

- A. Install flashings in accordance with NRCA requirements.

- B. Weather lap joints minimum 2 inches (50 mm) and seal weather tight with plastic cement.
- C. Secure in place with nails at 4 inches on center. Conceal fastenings.
- D. Items Projecting Through or Mounted on Roofing: Flash and seal weather tight with plastic cement.

### **3.6 INSTALLATION - SHINGLES**

- A. Install shingles in accordance with manufacturer's instructions.
  - 1. Fasten individual shingles using 2 nails per shingle, or as required by code, whichever is greater.
  - 2. Fasten strip shingles using 4 nails per strip, or as required by code, whichever is greater.
- B. Place shingles in straight coursing pattern with 5 inch (125 mm) weather exposure to produce double thickness over full roof area. Provide double course of shingles at eaves.
- C. Project first course of shingles 3/4 inch (19 mm) beyond fascia boards.
- D. Extend shingles 1/2 inch (13 mm) beyond face of gable edge fascia boards.
- E. Extend shingles on one slope across valley and fasten. Trim shingles from other slope 2 inches (50 mm) from valley center line to achieve closed cut valley, concealing the valley protection.
- F. Cap hips with individual shingles, maintaining 5 inch (125 mm) weather exposure. Place to avoid exposed nails.
- G. Cap ridge vent with individual shingles, maintaining 5 inch weather exposure. Place to avoid exposed nails.
- H. Coordinate installation of roof mounted components or work projecting through roof with weather tight placement of counterflashings.
- I. Complete installation to provide weather tight service.

### **3.7 PROTECTION**

- A. Do not permit traffic over finished roof surface.

**END OF SECTION 07 3113**

**SECTION 07 4600  
VINYL SIDING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Vinyl clapboard siding, soffit, and accessories.

**1.2 REFERENCES**

- A. Vinyl Siding Institute (VSI).

**1.3 SUBMITTALS**

- A. Product data for each type of product specified, including details of construction relative to materials, dimensions of individual components, profiles, textures, and colors.
- B. Samples for initial selection purposes in form of manufacturer's sample finishes showing full range of colors, profiles, and textures available.
- C. Samples for verification purposes in form of two full-size units of each type of siding and accessory required.

**1.4 QUALITY ASSURANCE**

- A. Source Limitation: Obtain each color, grade, finish, type, and variety of siding and related accessories from a single source.
- B. Installer Qualifications: Engage an installer who has successfully completed VSI's certification program.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in manufacturer's unopened bundles or containers with labels intact.
- B. Handle and store materials at Project site to prevent water damage, staining, or other physical damage. Comply with manufacturer's recommendations for job sit storage, handling and protection.

**1.6 PROJECT CONDITIONS**

- A. Weather Conditions: Proceed with siding installation only when existing and forecasted weather conditions will permit siding to be installed in compliance with manufacturer's recommendations and when substrate is completely dry.

**1.7 EXTRA MATERIALS**

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents. Furnish quantity of siding equal to 2 percent of amount installed.

**1.8 WARRANTY**

- A. Special Project Warranty: Manufacturer's written agreement to repair or replace siding that fails in materials or workmanship within the specified warranty period.
- B. Failures include, but are not limited to:
  - 1. Deformation or deterioration of siding beyond normal weathering.
- C. Warranty period is 20 years after the date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 VINYL CLAPBOARD SIDING**

- A. Formed Vinyl Siding and ventilating soffit: Solid extruded PVC siding, soffit, and accessories fabricated from virgin polyvinyl chloride compound complying with ASTM D 3679:
  - 1. Panels: 8-inch exposure, double 4-inch style, Shingles staggered, self-weeping.
  - 2. Unit Length: 12'-6"
  - 3. Texture: Simulated wood grain.
  - 4. Thickness: .040 -.042" nominal thickness.

5. Soffit and accessories colors will be selected by the Architect from manufacturer's standards.
- B. Acceptable Manufacturers:
  1. Certainteed (Basis of Design)
  2. Alside

## **2.2 ACCESSORIES**

- A. General: Furnish and install all accessories for siding work as recommended by the manufacturer and Vinyl Siding Institute Standards to result in a complete, weathertight installation.
- B. Vinyl Accessories: Furnish and install vinyl accessories, including "J" channels, inside, and outside corners (4"), moldings, and other items for complete installation in accordance with the manufacturer's printed installation instructions and product data.
- C. Vinyl Dryer Vent Covers: Vinyl dryer vent hood, louvered design to prevent intrusion of birds and rodents, size to fit existing vent ductwork. Provide Eastern Sales Product No. GDVC-200 "S."
- D. Head flashing, drip edge, gutters, and downspouts are specified in Section 07 6200 – "Sheet Metal Flashing and Trim."
- E. *Fasteners: Noncorrosive aluminum siding nails, of length sufficient to penetrate minimum of 1 inch into substrate. Provide prefinished fasteners in color to match siding where face nailing is unavoidable.*
- F. *Decorative Louvers – Basis of Design: similar to Lowes Ekena Millwork 24-inch w x 24-inch H round surface mount PVC Gable Vent, non-functional, color: white.*

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates for compliance with requirements for substrates, installation tolerances, and other conditions affecting performance of siding. Do not proceed with installation until unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Clean substrates of projections and substances detrimental to application.
- B. Coordinate installation with flashing and other adjoining construction to ensure proper sequencing.

### **3.3 INSTALLATION**

- A. Comply with siding manufacturer's installation instructions and recommendations. Center nails in elongated nailing slots without binding siding to allow for thermal movement. Install trim and accessories in accordance with manufacturer's recommendations. Overlap butt joints to shed water away from direction of prevailing wind. Isolate dissimilar metals.
- B. Provide sufficient material and use optimum joining arrangement so that short scrap pieces are not used to compose runs of siding.
- C. Account for expansion in accordance with the installation standards of the Vinyl Siding Institute.

### **3.4 ADJUSTING**

- A. Replace damaged siding materials with new materials complying with specified requirements.

### **3.5 CLEANING**

- A. Clean finished surfaces as recommended by siding manufacturer, and maintain in a clean condition during construction.

**END OF SECTION 07 4600**

**SECTION 07 4646  
FIBER CEMENT SIDING**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Fiber cement exterior fascia panels.
- B. Fiber cement exterior soffit panels.
- C. Reveals, trim boards and accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 06 1000 Rough Carpentry
- B. Section 07 2100 Thermal Insulation
- D. Section 07 2500 Weather Barriers
- E. Section 07 6200 Sheet Metal Flashing and Trim
- F. Section 07 9200 Joint Sealers
- G. Section 09 9000 Painting and Coating

**1.3 REFERENCE STANDARDS**

- A. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets; current edition.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Manufacturer's requirements for related materials to be installed by others.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Installation methods, including nail patterns.
- C. Test Report: Applicable model code authority evaluation report (e.g. ICC-ES).
- D. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.
- E. Warranty: Submit copy of manufacturer's warranty, made out in Owner's name, showing that it has been registered with manufacturer.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum 3 years of experience.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

**1.7 WARRANTY**

- A. Manufacturer's Warranty:
  - 1. Hardie Panel Limited Product Warranty: 30 year limited product warranty against manufacturing defects in material and workmanship, resist damage caused by hail or termite attacks.
    - a. Application Warranty: Application limited warranty for 5 years.
  - 2. HardiePlank Limited Product Warranty: 30 year limited product warranty against manufacturing defects in material and workmanship, resist damage caused by hail or termite attacks.
    - a. Application Warranty: Application limited warranty for 5 years.
  - 3. Hardie Trim Board Limited Product Warranty: 15 year limited product warranty against manufacturing defects in material and workmanship, resist damage caused by hail or termite attacks.
    - a. application Warranty: Application limited warranty for 5 years.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis of Design: James Hardie Building Products, Inc.: [www.jameshardiecommercial.com](http://www.jameshardiecommercial.com).

### **2.2 LAP SIDING**

- A. Lap Siding: Individual horizontal boards made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
1. Style: Standard lap style.
  2. Texture: Wood
  3. Length: 12 ft, nominal.
  4. Width (Height): 4 and 8 inches (exposure)
  5. Thickness: 5/16 inch, nominal.
  6. Finish: Factory Finish from manufacturers standard colors.
  7. Warranty: 30 year limited; transferable.
  8. Lap Siding Manufacturers:
    - a. Basis of Design: James Hardie Products, Inc.: [www.jameshardie.com](http://www.jameshardie.com). Lap Siding
    - b. Other Approved Manufacturer's
      - 1) Certainteed Corporation [Weather Boards]: [www.certainteed.com](http://www.certainteed.com).
      - 2) Nichiha USA, Inc : [www.nichiha.com](http://www.nichiha.com).
      - 3) Versatex: [www.versatex.com](http://www.versatex.com).

### **2.3 BUILDING TRIM:**

- A. Building Trim: Horizontal trim made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
1. Texture: Smooth.
  2. Length (Height): 12 ft, nominal.
  3. Width: see drawings
  4. Thickness: 5/16 inch, nominal.
  5. Finish: Factory Finish from manufacturers standard colors.
  6. Warranty: 30 year limited; transferable.
  7. Manufacturer's Climate Zone product: HZ5 for freezing wet climates with a green tint primer.
  8. Refer to [hardiezone.com](http://hardiezone.com) to identify the specific zone for this project.
  9. Code Compliance Requirement for Siding Materials:
    - a. Fiber-cement siding, complies with ASTM C 1186, Type A, Grade II.
    - b. Fiber-cement siding, complies with ASTM E 136 as a noncombustible material.
    - c. Fiber-cement siding, complies with ASTM E 84 Flame Spread Index = 0, Smoke Developed Index = 5.
    - d. Fiber-cement siding, complies with ASTM E 119, 1 hour and 2 hour fire resistive assemblies listed with Warnock Hersey.
    - e. Fiber-cement siding, tested to ASTM E 330 for Transverse Loads.
    - f. Intertek Warnock Hersey Product Listing.
    - g. Manufacturer's Technical Data Sheet.
  10. Trim Manufacturers:
    - a. Basis of Design: James Hardie Building Products, Inc : [www.jameshardie.com](http://www.jameshardie.com).
    - b. Certainteed Corporation [Weather Boards]: [www.certainteed.com](http://www.certainteed.com).
    - c. Nichiha USA, Inc : [www.nichiha.com](http://www.nichiha.com).
    - d. Versatex: [www.versatex.com](http://www.versatex.com).
- B. Soffit Panels: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1186 Type A Grade II; with machined edges, for nail attachment.
1. Texture: Vented Smooth.



2. Length: 96 inches or 144 inches, nominal.
3. Width: 12 inch to 24 inch wide vented (perforated) soffit panels.
4. Ventilation Area: Minimum 5 sq. in. of net free ventilation per lineal foot of soffit.
5. Accessories: Provide insect screen as specified below.
6. Thickness: 1/4 inch, nominal.
7. Finish: Factory Finish from manufacturers standard colors.
8. Manufacturer:
  - a. Basis of Design: James Hardie Building Products, Inc.: [www.jameshardiecommercial.com](http://www.jameshardiecommercial.com).
  - b. Certainteed Corporation [Weather Boards]: [www.certainteed.com](http://www.certainteed.com).
  - c. Nichiha USA, Inc.: [www.nichiha.com](http://www.nichiha.com).
  - d. Versatex: [www.versatex.com](http://www.versatex.com).

## 2.4 ACCESSORIES

- A. Furring Strips: Galvanized metal channels.
- B. Trim for use at Building Panels: Basis of Design: Reveal Trims in the following profiles supplied by James Hardie. Reveal Trims conform to a 6063 alloy in T-5 temper with a minimum thickness of 0.050 inch.
  1. Horizontal Trim: Xtreme Trim Zeam Z Bar Universal; Item No. VZBHD10.
  2. Vertical Trim: Xtreme Trim Vertical Reveal; Item No. VCVR1210.
  3. Butt Joint Trim: Xtreme Trim Panelseam T-Mold; Item No. VCTM258 Heavy Duty.
  4. Outside Corner Trim: Xtreme Trim Panelcorner Open Outside Corner; Item No. VCOOC10.
  5. Inside Corner Trim: Xtreme Trim Panelcorner Inside Corner: Item No. VCIPC10.
  6. J Channel Trim: Xtreme Trim J-Mold; Item No. JMHD51610.
  7. Window Head Flashing: Xtreme Trim Window Flashing; Item No. VWF1128.
  8. Soffit Joint Channel: Xtreme Trim Soffit H-Mold; Item No. VCHM51612.
- C. Trim for use at Lap Siding: Basis of Design: Reveal Trims in the following profiles supplied by James Hardie. Reveal Trims conform to a 6063 alloy in T-5 temper with a minimum thickness of 0.050 inch.
  1. Outside Corner Trim: Xtreme Trim Panel Bullnose Outside Corner: Item No. VCPKBOC10.
  2. Inside Corner Trim: Xtreme Trim Permacorner Inside Corner: Item No. VCICJ
  3. J Channel Trim: Xtreme TRim J-Mold; Item No. JMHD51610.
  4. Window Head Flashing: Xtreme Trim Window Flashing; Item No. VWF1128.
  5. Lap Starter Strip: Lap Start Strip; Item No. VCSS5168.
- D. Finishes of Reveal Trims:
  1. Chem Film for field painting of Reveal Trims; Chem Film Coating shall conform to ASTM N D 1730.
- E. Fasteners: For attaching Hardie Vertical Siding Panel to a rain screen provide the following:
  1. Wood Framing: (10-12) 1-1/2 inch long x 0.47 inch HD low profile Torx (T20W) (TW-S-D12-4.8x38).
  2. Fasteners shall be high quality stainless steel to ensure resistance to corrosion. for field painting, fasteners should be treated to accept paint adhesion.
    - a. Alternatives must be approved by the Architect, e.g. decorative screws, nails, bugle head screws, etc.
- F. Soffit Insect Screen: 18 x 16 size aluminum mesh.
  1. Cut screen to fit so that it covers the vent holes and overlaps the non-vented area of the soffit by 1 in to 2 inches. Secure screen to the backside of the soffit panels using a bead of construction adhesive.
- G. Joint Sealer: As specified in Section 07 9200.
- H. Finishes:
  1. Factory Primer: Provide factory applied universal primer.
    - a. Primer: Factory applied sealer/primer by James Hardie. Apply flat sheen finishes to panels.

- b. Topcoat: Refer to Section 09 9000 and Exterior Finish Schedule (100% acrylic paint finish recommended).
- 2. Factory Finish for Trim:
  - a. Trim to receive Factory-Applied Primer Coating (Chem-Film) and Field-Applied Finish.
  - b. Field Applied Finish Topcoat: Refer to Section 09 9000 and Exterior Finish Schedule (100% acrylic paint finish recommended).

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Examine substrate and clean and repair as required to eliminate conditions that would be detrimental to proper installation.
- B. Verify that weather barrier has been installed over substrate completely and correctly.
- C. Do not begin until unacceptable conditions have been corrected.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Install sheet metal flashing as indicated on drawings:
  - 1. Window or door head trim drip edge flashing.

#### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and recommendations.
  - 1. Read warranty and comply with all terms necessary to maintain warranty coverage.
  - 2. Install in accordance with conditions stated in model code evaluation report applicable to location of project.
  - 3. Use trim details indicated on drawings.
  - 4. Touch up all field cut edges before installing.
  - 5. Pre-drill nail holes if necessary to prevent breakage.
- B. Over Wood and Wood-Composite Sheathing: Fasten siding through sheathing into studs.
- C. Over Foam Sheathing: Read and comply with sheathing manufacturer's recommendations.
  - 1. For sheathing of 1 inch (25 mm) thickness or less, nail through sheathing into studs using correspondingly longer nails.
  - 2. For sheathing over 1 inch (25 mm) thickness, install furring strips over studs and fasten siding through furring and into studs.
- D. Install soffit panels on nominal 2 x 4 framing members spaced a maximum of 24 inches on center.
- E. Joints in Horizontal Siding: Avoid joints in lap siding except at corners; where joints are inevitable stagger joints between successive courses.
- F. Joints in Vertical Panels: Install Z-flashing in horizontal joints between successive courses of vertical siding.
- G. After installation, seal all joints except lap joints of fascia boards. Seal around all penetrations. Paint all exposed cut edges.
- H. Finish Painting: Specified in Section 09 9000.

#### **3.3 PROTECTION**

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 07 4646**

**SECTION 07 6200  
SHEET METAL FLASHING AND TRIM**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Metal counter flashing
- B. Miscellaneous sheet metal accessories
- C. Shop-finished aluminum sheet for wrapping wood where indicated.

**1.2 RELATED SECTIONS**

- A. 07 0500 – Common Work Results for Thermal and Moisture Protection

**1.3 REFERENCES**

- A. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
  - 1. Architectural Sheet Metal Manual.
- B. American Society for Testing and Materials (ASTM).
  - 1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 2. ASTM D 2822 Standard Specification for Asphalt Roof Cement.
- C. National Roofing Contractor's Association (NRCA)

**1.4 SUBMITTALS**

- A. Product data, Flashing, Sheet Metal, and Accessories: Manufacturer's technical product data, installation instructions and general recommendations for the following:
  - 1. Through-wall masonry flashing and accessories.
  - 2. Metal coping.
- B. Manufacturer's color charts showing full range of available selections.
- C. Samples of the following flashing, sheet metal, and accessory items:
  - 1. 8-inch-square samples of specified sheet materials to be exposed as finished surfaces.
  - 2. 12-inch-long samples of factory-fabricated products exposed as finished work.
- D. Shop drawings showing layout, profiles, details of running joints, reglets, methods of joining, and anchorage details, including major counterflashings. Provide layouts at 1/4-inch scale and details at 3-inch scale of the following:
  - 1. Metal flashing.

**1.5 PROJECT CONDITIONS**

- A. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

**PART 2 - PRODUCTS**

**2.1 SHEET METAL FLASHING AND TRIM MATERIALS**

- A. Zinc-Coated Steel: Commercial quality with 0.20 percent copper, ASTM A 653, G90 hot-dip galvanized, mill phosphatized where indicated for painting;
  - 1. Uncoated steel sheet thickness: 0.0239 -inch thick (24 gage).
- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with **smooth, flat** surface.
  - 1. Thickness: 0.032"
  - 2. Finish: 2-coat fluoropolymer (e.g. Kynar), color as selected by the Architect.

**2.2 MISCELLANEOUS MATERIALS AND ACCESSORIES:**

- A. Fasteners: Same metal as flashing/sheet metal or other non-corrosive metal as recommended by sheet manufacturer. Match finish of exposed heads with material being fastened.
  - 1. Provide watertight EPDM washers for fasteners exposed to the weather.

- B. Bituminous Coating: SSPC - Paint 12, solvent-type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coat.
- C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, non-drying, nonmigrating sealant.
- D. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 7 Section "Joint Sealants."
- E. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.
- F. Adhesives: Type recommended by flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.
- G. Reglets: Metal units of type and profile required for proper attachment, compatible with flashing indicated, noncorrosive.
- H. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of work, matching or compatible with material being installed, noncorrosive, size and gage required for performance.
- I. Elastic Flashing Filler: Closed-cell polyethylene or other soft closed-cell material recommended by elastic flashing manufacturer as filler under flashing loops to ensure movement with minimum stress on flashing sheet.
- J. Roofing Cement: ASTM D 2822, asphaltic.

### **2.3 FABRICATED UNITS**

- A. General Metal Fabrication: Shop-fabricate work to greatest extent possible. Comply with details shown and with applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance, with expansion provisions for running work, sufficient to permanently prevent leakage, damage, or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without excessive oil-canning, buckling, and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.
- B. Separations: Provide for separation of metal from incompatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with bituminous coating or other permanent separation as recommended by manufacturer/fabricator.

### **2.4 METAL COUNTERFLASHING**

- A. Metal Fascia System: Complete system, including cleats, splice plates, and fasteners:
  - 1. Joint configuration: SMACNA J2 (butt seam with back-up plate), no exposed fasteners on building face side.
  - 2. Finish: 2-coat fluoropolymer, 20-year fade warranty.
  - 3. Color: Selected by the Architect from the manufacturer's standard color selections.
- B. Metal Counterflashing: Provide as detailed.
  - 1. Finish: 2-coat fluoropolymer, 20-year fade warranty.
  - 2. Color: Selected by the Architect from the manufacturer's standard color selections.
- C. Acceptable Manufacturers:
  - 1. W.P. Hickmann
  - 2. Metal-Era

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Comply with referenced standards and manufacturer recommendations for preparing substrates to receive sheet metal fabrications.
- B. Isolate dissimilar metals in accordance with referenced standards.

### **3.2 INSTALLATION REQUIREMENTS**

- A. Furnish attachment devices to be embedded in concrete or masonry to the respective trade installing such items.
- B. General: Except as otherwise indicated, comply with manufacturer's installation instructions and recommendations and with referenced SMACNA and NRCA standards. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weatherproof.

### **3.3 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Touch up marred or damaged metal surfaces in a manner acceptable to the Architect. Remove and replace materials that cannot be repaired satisfactorily.
- C. Protection: Advise Contractor of required procedures for protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration other than natural weathering at time of Substantial Completion.

**END OF SECTION 07 6200**

**SECTION 07 7123  
MANUFACTURED GUTTERS AND DOWNSPOUTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Pre-finished galvanized steel gutters and downspouts.

**1.2 RELATED SECTIONS**

- A. 07 0500 – Common Work Results for Thermal and Moisture Protection

**1.3 REFERENCE STANDARDS**

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels; current edition.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; current edition.
- C. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; current edition.
- D. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; current edition.

**1.4 DESIGN REQUIREMENTS**

- A. Conform to SMACNA Architectural Sheet Metal Manual for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.
- B. Conform to applicable code for size and method of rain water discharge.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- C. Product Data: Provide data on prefabricated components.
- D. Samples: Submit two samples, 4 inch long illustrating component design, finish, color, and configuration.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Pre-Finished Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 0.02 inch (0.6 mm) thick base metal.
  - 1. Finish: Shop pre-coated with PVDF (polyvinylidene fluoride) coating.
  - 2. Color: As selected from manufacturer's standard colors.

**2.2 COMPONENTS**

- A. Gutters: Profile as indicated.
- B. Downspouts: Profile as indicated.
- C. Fasteners: Galvanized steel, with soft neoprene washers.

**2.3 ACCESSORIES**

- A. Splash Pads: Precast concrete type, size and profiles indicated; minimum 3000 psi (21 MPa) at 28 days, with minimum 5 percent air entrainment.

## **2.4 FABRICATION**

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

## **2.5 FACTORY FINISHING**

- A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as scheduled.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that surfaces are ready to receive work.

### **3.2 PREPARATION**

- A. Paint concealed metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil (0.4 mm).

### **3.3 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Connect downspouts to storm sewer system. Grout connection watertight.

**END OF SECTION 07 7123**

## **SECTION 07 8400 FIRESTOPPING**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire-resistance rated and smoke-resistant assemblies, and other openings indicated.

#### **1.2 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.
- C. Section 07 0500 – Common Work Results for Thermal and Moisture Protection

#### **1.3 REFERENCE STANDARDS**

- A. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops; current edition.
- B. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; current edition.
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; current edition.
- D. ASTM E2837 - Standard Test Method for Determining Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; current edition.
- E. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- F. FM 4991 - Approval of Firestop Contractors; Factory Mutual Research Corporation; current edition.
- G. FM P7825 - Approval Guide; Factory Mutual Research Corporation; current edition.
- H. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Underwriters Laboratories Inc.; current edition.
- I. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

#### **1.4 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.
  - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  - 1. Trained by the manufacturer.
  - 2. Approved by Factory Mutual Research under FM Standard 4991, Approval of Firestop Contractors,
  - 3. With minimum 3 years documented experience installing work of this type.
  - 4. Able to show at least 5 satisfactorily completed projects of comparable size and type.
  - 5. Licensed by authority having jurisdiction.

#### **1.5 MOCK-UP**

- A. Install one firestopping assembly representative of each fire rating design required on project.
  - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.



2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft (1/3 linear m).
- B. Obtain approval of authority having jurisdiction before proceeding.
- C. If accepted, mock-up will represent minimum standard for the Work.
- D. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

## **1.6 FIELD CONDITIONS**

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. A/D Fire Protection Systems Inc
- B. 3M Fire Protection Products
- C. Hilti, Inc
- D. Nelson FireStop Products

### **2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
  1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
  2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
  3. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
  4. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Head-of-Wall Firestopping at Joints Between Non-Rated Floor and Fire-Rated Wall: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
  1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
  1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
  2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
  3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.
  4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- D. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
  1. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
  2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
  3. Watertightness: In addition, provide systems that have been tested to show W Rating as indicated.

4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify openings are ready to receive the work of this section.

#### **3.2 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to arrest liquid material leakage.

#### **3.3 INSTALLATION**

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling required by code.

#### **3.4 CLEANING**

- A. Clean adjacent surfaces of firestopping materials.

#### **3.5 PROTECTION**

- A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION 07 8400**

**SECTION 07 9200  
JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Joint preparation
- B. Backing materials including primers, backer rods, bond breakers and accessories
- C. Elastomeric joint sealants.
- D. Related Section:
  - 1. 07 0500 – Common Work Results for Thermal and Moisture Protection.

**1.2 SUBMITTALS**

- A. Product data including samples and manufacturer's surface preparation and installation instructions.
  - 1. Include list of primers recommended for each application.
  - 2. Submit samples of each color required for each type of joint sealer exposed to view in duplicate.
  - 3. Certifications: Indicate compliance with standards specified in duplicate.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. All materials shall be verified by this Contractor to be compatible with adjacent materials.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Section 07 0500.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

**1.5 WARRANTY**

- A. Special Warranty: Submit two copies of a written guarantee agreeing to repair or replace joint sealers which fail to perform as air tight and water-tight joints; or fail in joint adhesion, cohesion, abrasion resistance weather resistance, or general durability; or appear to deteriorate or become unserviceable or causing an objectionable appearance resulting from either defective or non-conforming materials and workmanship or in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. Provide one-year Warranty
  - 1. Defects include, but are not limited to:
    - a. Staining from abutting materials or filler.
    - b. Migrating, bleeding into, or staining abutting materials.
    - c. Unsightly surface deformation by causes other than movement.
    - d. Excessive color change, chalking, or dust pick-up.
    - e. Railing adhesively or cohesively where maximum elongation is less than 25% of designed width of exposed joints.
    - f. Hardening to more than 25% over specified hardness.
      - 1) Replace sealants which fail because of loss of cohesion or adhesion or do not cure.

## **PART 2 - PRODUCTS**

### **2.1 SEALANTS, GENERAL**

- A. Colors: As shown on the Drawings or if not shown, match sealant material to colors of adjacent materials, as approved by Architect, unless indicated otherwise.
- B. Elastomeric Sealant Standard: ASTM C920 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C920 classifications for type, grade, class, and uses.
- C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
- D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- E. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.

### **2.2 JOINT SEALANTS**

- A. Sanitary Sealant, Interior Use: One component silicone rubber sealant.
  - 1. ASTM C920, Type S, Grade NT, Class 25, and FS-TT-S-1543B, Class A.
  - 2. Provide acid cure, nonporous bond type, mildew resistant silicone rubber where both joint faces are metal, glass, plastic, tile, or other non-porous material.
  - 3. Interior Joints Not Subject to Movement: One part, gun grade, acrylic latex.
    - a. ASTM C834, Type OP, Grade NF, with 10 year life expectancy.
  - 4. Interior Joints subject to Movement: Single-component, Nonsag, Urethane Joint Sealant.
    - a. ASTM C 920, Type S, Grade NS, Class 25, for Use NT and FS-TT-S230 with 20-year life expectancy.
    - b. Colors: Match sealant material to colors of adjacent materials, as selected by Architect from manufacturer's standard colors.
  - 5. Exterior joints greater than 1/2" [(except E.I.F.S. areas)]: Multicomponent, Nonsag, Urethane Joint Sealant:
    - a. ASTM C920, Type M, Grade NS, Class 50, for Use NT with 20 year life expectancy.
    - b. Colors: Match sealant material to colors of adjacent materials, as selected by Architect from manufacturer's standard colors.
  - 6. Exterior joints less than 1/2" (except E.I.F.S. areas): Single component, Nonsag, Urethane Joint Sealant:
    - a. ASTM C920, Type S, Grade NS, Class 25, for Use NT with 20-year life expectancy.
    - b. Colors: Match sealant material to colors of adjacent materials, as selected by [Architect] [Owner's Representative] from manufacturer's standard colors.
  - 7. Exterior Joints at E.I.F.S. Areas: Provide sealant materials known to be compatible with the exterior insulation finish system (E.I.F.S.). Product utilized shall be verified by this Contractor for approval with E.I.F.S. manufacturer utilized on this Project.
    - a. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 50, for Use NT.
  - 8. Sealant Materials - Glazing: composition shall be a silicone base, single component, solvent curing, capable of withstanding movement of up to 50 percent of joint width and shore a hardness of 26.
    - a. ASTM C920, TTS-S-001543A and TT-S-00230C (COM-NBS).

### **2.3 ACCESSORIES**

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

- C. Joint Filler Backer Rod: ASTM D1056; D1565; round, closed cell polyethylene, non-gassing rod sized to produce 25% compression when installed in joint.
- D. Cleaners for Nonporous Surfaces: Provide nonstaining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent nonporous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.
  - 1. Provide cleaner conditioner required for glass and glazed surfaces as recommended by sealant manufacturer.
  - 2. Masking Tape: Provide nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

## **PART 3 - EXECUTION**

### **3.1 PROJECT CONDITIONS**

- A. Environmental Limitations: 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 degrees F. and less than 100 degrees F.
  - 2. When joint substrates are wet.
  - 3. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

### **3.2 EXAMINATION**

- A. Examine joints indicated to receive joint sealers, with Installer present, for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Do not proceed with installation of joint sealers until unsatisfactory conditions have been corrected. Beginning of Installation means acceptance of all existing conditions making this Contractor responsible for correcting all unsatisfactory and defective work encountered at his expense.

### **3.3 PREPARATION**

- A. Surface Preparation: Clean joints immediately before installing backers and sealants to comply with recommendations of joint sealer manufacturers and the following requirements:
  - 1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealers; oil; grease; waterproofing; water repellents; water; surface dirt; and frost.
  - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Remove laitance and form release agents from concrete.
  - 3. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond, do not allow spillage or migration onto adjoining surfaces.
  - 4. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears such as masonry or EIFS materials. Remove tape immediately after tooling without disturbing joint seal.

### **3.4 INSTALLATION OF JOINT SEALERS**

- A. General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply. Surfaces and air temperature shall be greater than 30 degrees F and less than 100 degrees F.

- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on reconstruction 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.
1. Ensure that primer fully covers surfaces to which sealant is to adhere.
  2. Apply with bristle brush. Do not flood surfaces.
  3. Allow primer to dry 30 minutes minimum or as recommended by manufacturer prior to application of backing rod and sealant.
  4. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
    - a. Do not leave gaps between ends of sealant backings.
    - b. Do not stretch, twist, puncture, or tear sealant backings.
    - c. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
  5. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure. Bond breaker must be used in all conditions where three-sided adhesion may be possible.
  6. Install sealants by proven techniques to comply with the following and at the same time backings are installed:
    - a. Place sealants so they directly contact and fully wet joint substrates.
    - b. Completely fill recesses provided for each joint configuration.
    - c. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
    - d. Joint Size:
      - 1) Depth of joint shall not exceed width of joint.
      - 2) Minimum depth: ¼"
      - 3) Maximum depth: ½"
  7. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
    - a. Remove excess sealants from surfaces adjacent to joint.
    - b. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
      - 1) Provide concave joint configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
      - 2) Provide flush joint configuration, per Figure 5B in ASTM C1193, where indicated.
      - 3) Provide recessed joint configuration, per Figure 5C in ASTM C1193, of recess depth and at locations indicated.
        - (a) Use masking tape to protect adjacent surfaces of recessed tooled joints.
        - (b) All joints shall be free of air pockets, foreign embedded matter, ridges, and sags.

### 3.5 CURE

- A. Cure sealant in compliance with manufacturer's instructions and recommendations to obtain high, early bond strength, internal cohesion strength and surface durability.

### 3.6 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur. Remove masking material immediately following sealant application.

### **3.7 PROTECTION**

- A. Protect joint sealers from damage until time of Substantial Completion. Cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials so that repairs are indistinguishable from original work.

### **3.8 SEALANT SCHEDULE**

- A. Work shall include providing sealant at the intersection of construction components of the interior and exterior of the building, including, but not limited to the following conditions:
  - 1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces:
    - a. Control and expansion joints in cast-in-place concrete
    - b. Control and expansion joints in unit masonry
    - c. Joints between different materials listed above
    - d. Perimeter joints between materials listed above and frames of doors and windows
    - e. Control and expansion joints in ceiling and overhead surfaces
    - f. Under thresholds
    - g. Other joints as indicated
    - h. Exterior joints in horizontal traffic surfaces.
  - 2. Interior joints in the following vertical surfaces and horizontal non-traffic surfaces:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated
    - c. Tile control and expansion joints.
    - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances
    - e. Joints between plumbing fixtures and adjoining walls, floors, and counters
  - 3. Other Interior joints:
    - a. Control and expansion joints in cast-in-place concrete slabs
    - b. Control and expansion joints in tile flooring
    - c. Joints at countertops, vanities
    - d. Under thresholds
    - e. Door bucks not flush with thresholds
    - f. Tubs, lavatories, water closets, and other plumbing fixtures
    - g. Other joints as indicated

**END OF SECTION 07 9200**

**SECTION 08 0500  
COMMON WORK RESULTS FOR OPENINGS**

**PART 1 - GENERAL**

**1.1 GENERAL CONDITIONS**

- A. The General Conditions, Modifications to General Conditions, Supplementary or Special Conditions and any Instructions to Bidders shall apply to all Divisions of the work.
- B. The requirements of State, Local or appropriate codes applicable to the work, whichever is the most stringent is a requirement of all Divisions of the work.

**1.2 SUMMARY**

- A. This Section includes common requirements for openings, including doors, frames, hardware, and glazing specified in subsequent Division 08 Sections.
- B. Related Work Specified in Other Sections:
  - 1. Section 04 2200 - "Unit Masonry".
  - 2. Section 06 1000 "Rough Carpentry" for concealed blocking, shims, and supplementary framing required for openings.
  - 3. Section 07 6200 "Sheet Metal Flashing and Trim" for flashing at openings.
  - 4. Section 07 9200 "Joint Sealants".

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. Sustainable Design Submittals: Refer to Section 01 8113 – Sustainable Design Requirements for the following:
  - 1. Recycled content
  - 2. Regional materials.
- B. VOC Content of Sealants: Refer to Section 01 6116 – Volatile Organic Content Restrictions and as follows:
  - 1. Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
    - a. Architectural Sealants: 250 g/L.
    - b. Sealant Primers for Nonporous Substrates: 250 g/L.
    - c. Sealant Primers for Porous Substrates: 775 g/L.
  - 1. VVOC Content of Coatings: Refer to Section 01 6116 – Volatile Organic Content Restrictions.
- C. Construction Waste Management: Comply with requirements of Section 01 7419 – Construction Waste Management and Disposal.

**1.4 REFERENCES**

- A. General: Section 01 4200 – Reference Standards.

**1.5 SUBMITTALS**

- A. See Section 01 3300 - Submittal Procedures.
- B. Shop Drawings: Submit detailed shop drawings for doors, windows, and other products in this Division.
- C. Schedules: Submit door and hardware schedule prepared by a qualified architectural hardware consultant. Use the same opening numbers as indicated on the Drawings.

**1.6 QUALITY ASSURANCE**

- A. General: Section 01 4000 – Quality Requirements and subsequent Division 8 Sections.
- B. Installer Qualifications: Engage only qualified installers to perform work.
- C. Regulatory Requirements: Comply with requirements of authorities having jurisdiction related to the following:
  - 1. Fire resistance of assemblies.
  - 2. Accessibility requirements.



- D. Source Limitation: Obtain each type of specified product from a single qualified manufacturer and distribution source.

### **1.7 COORDINATION**

- A. General: Section 01 3000 – Administrative Requirements, 01 4000 – Quality Requirements, and subsequent Division 8 Sections.
- B. Perform field measuring to determine dimensions for rough openings and existing openings to receive new doors and windows. Record field measurements on shop drawings and retain for record.
- C. Furnish templates, setting diagrams, and other information necessary for shop fabrication and assembly of specified products, in sufficient time to maintain the Project Schedule.
- D. Furnish installation information to other trades to ensure preparation of openings by other trades is performed in accordance with the Contract Documents, approved Shop Drawings, and the manufacturer's recommendations.
- E. Prepare doors and frames to receive scheduled hardware using templates provided by the approved hardware manufacturers.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's delivery, storage, and handling information.
- B. Establish proper storage conditions at shops, the site, and other points of delivery to prevent loss, deterioration, damage, and theft.
  - 1. Provide temporary heat and humidity control if required to achieve the conditions required by referenced standards and manufacturer's instructions.
  - 2. Provide secure lock-up for hardware products.
  - 3. Store doors and frames in accordance with referenced standards to prevent warping, condensation, and incidental damage at the site.
- C. Inspect and inventory products upon delivery. Reject defective or damaged products and promptly remove them from the Site.

## **PART 2 - PRODUCTS**

### **2.1 PRODUCTS, GENERAL**

- A. Refer to Section 01 6000 – Product Requirements and referenced Division 08 Sections.

## **PART 3 - EXECUTION**

### **3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution and Closeout Requirements and referenced Division 08 Sections.

### **3.2 INSPECTION**

- A. Verify acceptability of rough opening conditions in accordance with referenced standards and manufacturer's instructions. Correct non-complying conditions, including removal of interfering elements, restoration of substrates, and installation of supplementary framing, blocking, and supports to stabilize and square the openings. Do not proceed with installation until objectionable conditions are corrected.

### **3.3 PREPARATION**

- A. Isolate framing components to prevent contact with incompatible substrates, including dissimilar metals to prevent galvanic reaction.
- B. Correct unacceptable conditions in existing substrates and existing frames and openings to ensure that finished work complies with regulatory requirements and operates properly.

### **3.4 INSTALLATION**

- A. Install products in accordance with the drawings, manufacturer's recommendations, and approved shop drawings.

- B. Arrange for connection of electrified components to building power supply by qualified personnel.

**3.5 OPERATION AND ADJUSTMENT**

- A. Test installed products to ensure proper operation.

**3.6 DEMONSTRATION AND TRAINING**

- A. Refer to Demonstration and Training requirements in Division 01 for proper operation and maintenance of installed products and to review troubleshooting procedures.

**END OF SECTION 08 0500**

**SECTION 08 1113  
HOLLOW METAL DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Steel doors
  - 1. Fire labelled
  - 2. Non-fire labelled
  - 3. Thermally insulated
  - 4. Non-insulated
- B. Steel frames for doors and glazed lights.
  - 1. Fire labelled
  - 2. Non-fire labelled

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 - Common Work Results for Openings
- B. Section 08 7100 - Door Hardware
- B. Section 08 8000 - Glazing
- C. Section 09 9000 - Painting

**1.3 REFERENCE STANDARDS**

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; current edition.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; current edition.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; current edition.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; current edition.
- E. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; current edition.
- F. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; current edition.
- G. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- H. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; current edition.
- I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; current edition.
- J. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- K. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

**1.4 SUBMITTALS**

- A. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Steel Doors and Frames:
  - 1. Ceco
  - 2. Curries
  - 3. Steelcraft

**2.2 DOORS AND FRAMES, GENERAL**

- A. Accessibility: Comply with ANSI/ICC A117.1.
- B. Door Top Closures: Flush with top of faces and edges.
- C. Door Edge Profile: Beveled on both edges.

- D. Door Texture: Smooth.
- E. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
- F. Galvanizing For Exterior and wet areas.: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.

## **2.3 STEEL DOORS**

- A. Exterior Doors:
  - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
  - 2. Core: Polystyrene foam.
  - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
  - 4. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
  - 5. Weatherstripping: Refer to Section 08 7100.
  - 6. Finish: Factory primed, for field finishing.
- B. Interior Doors, Non-Fire-Rated:
  - 1. Grade: ANSI A250.8 Level 1, physical performance Level C, Model 1, full flush.
- C. Interior Doors, Fire-Rated:
  - 1. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
    - a. Provide units listed and labeled by UL or WH.
    - b. Attach fire rating label to each fire rated unit.
  - 2. Core: Mineral fiberboard.
  - 3. Finish: Factory primed, for field finishing.

## **2.4 STEEL FRAMES**

- A. General:
  - 1. Comply with the requirements of grade specified for corresponding door.
  - 2. Finish: Same as for door.
- B. Exterior Door Frames: Face welded, seamless with joints filled.
  - 1. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire-Rated: Fully welded type.
  - 1. Terminated Stops: Provide at all interior doors; closed end stop terminated 6 inches (150 mm) above floor at 45 degree angle.
- D. Interior Door Frames, Fire-Rated: Welded.
  - 1. Fire Rating: Same as door, labeled.

## **2.5 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

### **3.2 PREPARATION**

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

### **3.3 INSTALLATION**

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. In addition, install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.

- D. Coordinate installation of hardware.
- E. Coordinate installation of glazing.

**3.4 TOLERANCES**

- A. Maximum Diagonal Distortion: 1/16 in (1.5 mm) measured with straight edge, corner to corner.

**3.5 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**END OF SECTION 08 1113**

**SECTION 08 1416  
FLUSH WOOD DOORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Solid core wood doors; flush configuration.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 – Common Work Results for Openings
- B. Section 08 8000 - Glazing.

**1.3 REFERENCE STANDARDS**

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; current edition.
- B. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

**1.4 SUBMITTALS**

- A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- B. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- C. Specimen warranty.
- D. Warranty, executed in Owner's name.

**1.5 QUALITY ASSURANCE**

- A. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

**1.7 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  - 1. Graham Wood Doors.
  - 2. Eggers Industries.
  - 3. Marshfield Door Systems, Inc.

**2.2 DOORS**

- A. All Doors: See drawings for locations and additional requirements.
  - 1. Quality Level: Premium Grade, in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.
  - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
  - 1. Provide solid core doors at all locations.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with International Building Code ("positive pressure"); UL or WH (ITS) labeled without any visible seals when door is open.
3. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure at both ambient and elevated temperatures; with "S" label; if necessary, provide additional gasketing or edge sealing.

### **2.3 DOOR AND PANEL CORES**

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated above.
- B. Fire Rated Doors: Mineral core, Type FD, plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

### **2.4 DOOR FACINGS**

- A. Wood Veneer Facing for Transparent Finish: White Birch, veneer grade as specified by quality standard, plain sliced, book veneer match, running assembly match; unless otherwise indicated.

### **2.5 ACCESSORIES**

- A. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- B. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- C. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

### **2.6 DOOR CONSTRUCTION**

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
  1. Provide solid blocks at lock edge for hardware reinforcement.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
  1. Exception: Doors to be field finished.
- E. Provide edge clearances in accordance with the quality standard specified.

### **2.7 FACTORY FINISHING - WOOD VENEER DOORS**

- A. Finish work in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
  1. Transparent:
    - a. System - 1, Lacquer, Nitrocellulose.
    - b. Sheen: Flat.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

### **3.2 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.

1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Field-Finished Doors: Trimming to fit is acceptable.
  1. Adjust width of non-rated doors by cutting equally on both jamb edges.
  2. Trim maximum of 3/4 inch (19 mm) off bottom edges.
  3. Trim fire-rated doors in strict compliance with fire rating limitations.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.

### **3.3 TOLERANCES**

- A. Conform to specified quality standard for fit and clearance tolerances.
- B. Conform to specified quality standard for telegraphing, warp, and squareness.

### **3.4 ADJUSTING**

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

**END OF SECTION 08 1416**



**SECTION 08 1614  
MOLDED PANEL INTERIOR DOORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Molded panel interiors doors.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 - Common Work Results for Openings

**1.3 REFERENCE STANDARDS**

- A. ASTM A 123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; current edition.
- B. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association; current edition.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard details, installation instructions, and hardware and anchor recommendations.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

**1.5 QUALITY ASSURANCE**

- A. Fire-Rated Mineral Core Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at according to NFPA 252.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
  - 1. Store at temperature and humidity conditions recommended by manufacturer.
  - 2. Do not use non-vented plastic or canvas shelters.
  - 3. Immediately remove wet wrappers.
- C. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inches space between doors.

**1.7 FIELD CONDITIONS**

- A. Do not install doors until structure is enclosed.
- B. Maintain temperature and humidity at manufacturer's recommended levels during and after installation of doors.

**1.8 WARRANTY**

- A. Provide five (5) year manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.

**PART 2 - PRODUCTS**

**2.1 MOLDED PANEL DOORS**

- A. Basis of Design Manufacturer: Masonite International Corporation
- B. Style: 2-panel
- C. Finish: Factory-primed, filed, painted. Refer to Section 09 9000.
- D. Types:

1. Solid particleboard core bonded to molded face sheets, 1-3/4" thick, mortised to receive 4" standard bearing hinges.

## 2.2 DOOR AND FRAME ASSEMBLIES

- A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
  1. Door and frame pre-assembled, complete with hinges; shipped with braces, spreaders, and packaging to prevent damage.
  2. Mechanical Durability: Tested to ANSI A250.4 Level A (1,000,000 cycles), minimum; tested with hardware and fasteners intended for use on project.
  3. Screw-Holding Capacity: Tested to 900 psi, minimum.
  4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less; when tested in accordance with ASTM E 84.
  5. Flammability: Self-extinguishing when tested in accordance with ASTM D 635.
  6. Clearance Between Door and Frame: 1/8 inch, maximum.
  7. Clearance Between Meeting Stiles of Pairs of Doors: 1/8 inch, maximum.
  8. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.
- B. Fire Rated Doors and Frames: Ratings indicated on drawings.

## 2.3 COMPONENTS

- A. Doors:
  1. Thickness: 1 3/8 inches, overall.
  2. Subframe and Reinforcements: Manufacturer's standard materials.
  3. Waterproof Integrity: All edges, cut-outs, and hardware preparations factory fabricated of fiberglass reinforced plastic; provide cut-outs with joints sealed independently of glazing or louver inserts or trim.
  4. Hardware Preparations: Factory reinforce, machine, and prepare for all hardware including field installed items; provide solid blocking for each hardware item; make field cutting, drilling or tapping unnecessary; obtain manufacturer's templates for hardware preparations.
  5. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain urea formaldehyde.
  6. Construction
    - a. Hardboard Facing
    - b. Composite Stiles and rails
    - c. Mineral Core Blocking.
    - d. Factory Finished
    - e. Pre-drilled hinges and bores for lock and other hardware.
    - f. Provide all Passage doors with Sound Solid Core construction
  7. Primer: Factory Primed - Ready For Painting
- B. Frames: Profiles and dimensions as indicated on drawings; same type and construction used in mechanical durability test for doors. Doors are to be pre-hung if conditions permit.
  1. Construction for Non-Fire-Rated Doors: Use one of the following:
    - a. Molded fiberglass with gel-coating matching doors.
    - b. Fiberglass pultrusions with gel-coating matching doors
    - c. Fiberglass pultrusions primed for field painting.
  2. Construction for Fire-Rated Doors: Provide frames bearing labels to match doors; use one of the following:
    - a. Galvanized steel, hot-dipped coated to G180/Z285 or ASTM A 123/A 123 M; 18 gage, 0.05 inch minimum thickness; degreased and primed for field painting.
    - b. Stainless steel, Type 304; 18 gage, 0.05 inch minimum thickness; No.4 satin brushed finish.
    - c. Fiberglass pultrusions primed for field painting.

3. Corner Joints: Mitered with concealed corner blocks or angles of same material as frame; fiberglass and aluminum joined with screws; steel and stainless steel spot welded; sealed watertight with silicone sealant.
  4. At hardware cut-outs provide continuous backing or mortar guards of same material as frame, sealed watertight.
  5. Frame Anchors: Stainless steel, Type 304; provide 3 anchors in each jamb for heights up to 84 inches with one additional anchor for each additional 24 inches in height.
- C. Transom and Other Panels: Same construction as doors.  
D. Hinge and Hardware Fasteners: Stainless steel, Type 304; wood screws.

## **2.4 ACCESSORIES**

- A. Hardware: As specified in Section 08 7100.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.  
B. Do not begin installation until substrates have been properly prepared.

### **3.2 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.  
B. Clean and prepare substrate in accordance with manufacturer's directions.  
C. Protect adjacent work and finish surfaces from damage during installation.

### **3.3 INSTALLATION**

- A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.  
B. Install fire-rated assemblies in accordance with NFPA 80.  
C. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.  
D. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.  
E. Repair or replace damaged installed products.

### **3.4 ADJUSTING**

- A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.  
B. Adjust hardware for smooth and quiet operation.  
C. Adjust doors to fit snugly and close without sticking or binding.

### **3.5 CLEANING**

- A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

### **3.6 PROTECTION**

- A. Protect installed products from damage during subsequent work.

**END OF SECTION 08 1614**

**SECTION 08 3113  
ACCESS DOORS AND FRAMES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes access doors and frames.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Include, finishes, and fire ratings (if required) for access doors and frames.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, details, and attachments to other Work.
- C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, suspension systems, piping, ductwork, and other construction. Show the following:
  - 1. Method of attaching door frames to surrounding construction.
  - 2. Ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim.

**1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 and tested for fire-test-response characteristics and that are labeled and listed by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 1013 for vertical access doors.
  - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- C. Non Rated Access Doors: Flush Access Doors with wall board bead for concealed look
- D. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. J. L. Industries
- B. Larsen Manufacturing
- C. Milcor

**2.2 MATERIALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B.
- C. Cold-Rolled Steel Sheets: Provide one of the following:
  - 1. ASTM A 366/A 366M, Commercial Steel (CS),
  - 2. ASTM A 620/A 620M, Drawing Steel (DS), Type B;
  - 3. ASTM A 591/A 591M, Class C coating Electrolytic zinc-coated steel sheet
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating;
- E. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304; with minimum sheet thickness indicated representing specified thickness according to ASTM A 480/A 480M.
- F. Drywall Beads: 0.0299-inch zinc-coated steel sheet sized for thickness of gypsum board.

### **2.3 PAINT**

- A. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

### **2.4 ACCESS DOORS AND FRAMES**

- A. Flush, Insulated, Fire-Rated Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.
  - 1. Locations: Masonry or ceramic-tile wall surfaces.
  - 2. Fire-Resistance Rating: Equal to that of adjacent construction.
  - 3. Door: 0.075-inch- thick steel, flush construction, insulated.
  - 4. Frame: 0.060-inch- thick steel with surface-mounted trim.
  - 5. Hinges: Concealed pin type.
  - 6. Automatic Closer: Spring type.
  - 7. Latch: Screwdriver-operated cam latch, except as noted below.
- B. Locking Devices:
  - 1. Provide cylinder locks where exposed to public. Keying shall comply with the Owner's requirements.

### **2.5 FABRICATION**

- A. Grind exposed welds smooth and flush with adjacent surfaces.
- B. Furnish attachment devices and fasteners of type required to secure access panels.
- C. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
- D. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.
- E. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.
- F. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

### **2.6 FINISHES, GENERAL**

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

### **2.7 STEEL FINISHES**

- A. Apply shop primer to uncoated metal surfaces per SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.
- B. Finish: Field-painted according to Section 09 9000 for interior primed ferrous metals.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Coordinate locations of access doors with other trades requiring them.
- B. Comply with manufacturer's written instructions for installing access doors and frames.
- C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- D. Install access doors with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

**END OF SECTION 08 3113**

**SECTION 08 3313  
COILING COUNTER DOORS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Non-fire-rated coiling counter doors and operating hardware.

**1.2 REFERENCE STANDARDS**

- A. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2008.
- B. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes Metric; 2007.

**1.3 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Samples: Submit two slats, 4 inches long illustrating shape, color and finish texture.
- E. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- F. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.

**PART 2 PRODUCTS**

**2.1 COILING COUNTER DOORS**

- A. Coiling Counter Doors, Non-Fire-Rated: Aluminum slat curtain.
  - 1. Mounting: Exterior face mounted.
  - 2. Nominal Slat Size: 1-1/4 inches wide.
  - 3. Slat Profile: Solid.
  - 4. Finish: Anodized.
  - 5. Guides: Formed track; same material and finish unless otherwise indicated.
  - 6. Hood: Manufacturer's standard.
  - 7. Operation: Manual hand crank lift operation.
  - 8. Interior latch with padlock hasp.

**2.2 MATERIALS**

- A. Curtain Construction: Interlocking, single thickness slats.
  - 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
  - 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
  - 3. Aluminum Slats: ASTM B 221 (ASTM B 221M), aluminum alloy Type 6063; minimum thickness 0.05 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
  - 1. Aluminum Guides: Extruded aluminum channel, with wool pile runners along inside.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
- D. Latching: Inside mounted, sliding deadbolt.
- E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that opening sizes, tolerances and conditions are acceptable.

### **3.2 INSTALLATION**

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

### **3.3 TOLERANCES**

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation from Plumb: 1/16 inch.
- C. Maximum Variation from Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

### **3.4 ADJUSTING**

- A. Adjust operating assemblies for smooth and noiseless operation.

### **3.5 CLEANING**

- A. Clean installed components.
- B. Remove labels and visible markings.

**END OF SECTION 08 3313**

**SECTION 08 4313  
ALUMINUM-FRAMED STOREFRONTS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Aluminum-framed storefront.
- B. Infill panels.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Door hardware.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 - Common Work Results for Openings
- B. Section 08 8000 - Glazing

**1.3 REFERENCE STANDARDS**

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; current edition.
- B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage; American Architectural Manufacturers Association (part of AAMA 501); current edition.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; current edition.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; current edition.
- E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; current edition.
- F. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; current edition.
- G. ASTM B 221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes Metric; current edition.
- H. ASTM E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; current edition.
- I. ASTM E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; current edition.
- J. ASTM E 547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; current edition.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with installation of other components that comprise the exterior enclosure.

**1.5 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.



- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

## 1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the State in which the Project is located.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

## 1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

## 1.9 WARRANTY

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. 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. Arch Aluminum & Glass Co., Inc.
  - 2. EFCO Corporation.
  - 3. Kawneer North America; an Alcoa company.
  - 4. Tubelite.

### 2.2 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  - 1. Glazing Position: CENTERED.
  - 2. Finish: High performance organic coating.
  - 3. Color: **clear anodized**.
- B. Performance Requirements:
  - 1. Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
    - a. Design Wind Loads: Comply with requirements of Ohio and Summit County code.
    - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
  - 2. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
  - 3. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E 283.
  - 4. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed.

5. Water Leakage: None, when measured in accordance with ASTM E 547 at specified pressure differential.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of infill panel and heel bead of glazing compound.
8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.

### **2.3 COMPONENTS**

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken.
  2. Glazing stops: Beveled.
  3. Cross-Section: As indicated on drawings.
  4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Doors: Glazed aluminum.
  1. Thickness: 1-3/4 inches.
  2. Top Rail: 4 inches wide.
  3. Vertical Stiles: 4-1/2 inches wide.
  4. Bottom Rail: 6 inches wide.
  5. Glazing Stops: Square.
  6. Finish: Same as storefront.

### **2.4 MATERIALS**

- A. Extruded Aluminum: ASTM B 221 (ASTM B 221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- D. Concealed Flashings: 0.018 inch thick galvanized steel.
- E. Glass: As specified in Section 08 8000.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

### **2.5 FINISHES**

- A. Class I Color Anodized Finish: AAMA 611 AA-M122242 Integrally colored anodic coating or AAMA 612 electrolytically deposited colored anodic coating with electrolytically deposited organic seal; not less than 0.7 mils thick.
- B. Color: To be selected by Architect from manufacturer's standard range.

### **2.6 HARDWARE**

- A. Door Hardware: Storefront manufacturer's standard type to suit application.

### **2.7 FABRICATION**

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.

- F. Reinforce components internally for door hardware.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

#### **3.2 INSTALLATION**

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install hardware using templates provided.
- L. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

#### **3.3 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

#### **3.4 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- B. Test installed storefront for water leakage in accordance with AAMA 501.2.

#### **3.5 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

#### **3.6 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

#### **3.7 PROTECTION**

- A. Protect installed products from damage during subsequent construction.

**END OF SECTION 08 4313**

**SECTION 08 5313  
VINYL WINDOWS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Vinyl-framed, factory-glazed windows, operable single-hung type.
- B. Operating hardware.
- C. Insect screens.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 – Common Work Results for Openings
- B. Section 07 2500 - Weather Barriers
- C. Section 07 6200 - Sheet Metal Flashing and Trim

**1.3 REFERENCE STANDARDS**

- A. AAMA/NWWDA 101/I.S. 2-97 - Voluntary Standard for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors.
- B. National Fenestration Rating Council:
  - 1. NFRC 100 - Procedure for Determining Fenestration Product U-Factors
  - 2. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
- C. ASTM International:
  - 1. ASTM D 3656 - Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Fiber Yarn.
  - 2. ASTM D 3678 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Interior Profile Extrusions.
  - 3. ASTM D 4028 - Standard Specification for Solar Screening Woven from Vinyl-Coated Fiber Glass Yarn.
  - 4. ASTM E 774 - Standard Specification for Sealed Insulating Glass.
- D. Insulated Glass Certification Council (IGCC): Classification of Insulating Glass Units.
- E. U.S. Department of Energy: ENERGY STAR® Program Requirements for Residential Windows, Doors, and Skylights

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene one week before starting work of this section.

**1.5 SUBMITTALS FOR REVIEW**

- A. Shop drawings showing details of fabrication, hardware, weatherstripping, fasteners, screens, glazing, accessories, and related items.
- B. Window schedule identifying each opening and size corresponding with the elevations on the Drawings.
- C. Manufacturer's full range of available color samples.

**1.6 SUBMITTALS FOR INFORMATION**

- A. Test Reports: For each window type specified, furnish test reports from accredited independent testing laboratory certifying that identical or larger window units meet requirements specified for air infiltration, water penetration and structural performance by AAMA/NWWDA 101/I.S. 2-97, for thermal performance by NFRC-97, and for seal integrity of insulating glass units by IGCC.

**1.7 CLOSEOUT SUBMITTALS**

- A. Warranty documents, properly executed.
- B. Maintenance Instructions

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- B. Jig, brace, and box the window frame assemblies for transport to minimize flexing of members or joints.

## **1.9 WARRANTY**

- A. Correct defective Work within a five year period after Date of Substantial Completion.
- B. Provide five year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same. Include coverage for degradation of color finish.

## **PART 2 - PRODUCTS**

### **2.1 VINYL WINDOWS**

- A. Basis of Design: Pella Encompass Single hung insulated windows, with LoE3 glass with Argon gas fill, Energy Star qualified for ASHRAE Climate Zone 5.
- B. Description: Factory fabricated frame and sash members of extruded hollow ultra-violet-resistant polyvinyl chloride (PVC) with integral color; with factory-installed glazing, hardware, related flashings, and anchorage and attachment devices. The Architect will select the color.
  - 1. Framing Members: Fusion welded corners and joints, with internal reinforcement where required for structural rigidity; concealed fasteners.
  - 2. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, or migrating moisture occurring within system.
  - 3. Provide each unit with manufacturer's standard half-height charcoal fiberglass insect screening.
- C. Window Unit Thermal Performance:
  - 1. U-Value:0.30
  - 2. Solar Heat Gain Coefficient:0.35
- D. Operable Sash Weatherstripping: Wool pile; permanently resilient, profiled to effect weather seal.
- E. Color: white.

### **2.2 HARDWARE**

- A. Single hung Sash: Metal and nylon spiral friction slide cylinder, each sash, each jamb.
- B. Sash lock: Lever handle with cam lock.
- C. Pulls: To be selected by the Architect.
- D. Window limiters are to be provided on all windows.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify wall openings and adjoining weather barrier materials are ready to receive work of this Section. Refer to Section 07 2500.
- B. Verify that head flashings are properly installed. Refer to Section 07 9200.

### **3.2 INSTALLATION**

- A. Install window units in accordance with manufacturer's instructions.
- B. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- C. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- D. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- E. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- F. Install operating hardware.

G. Install perimeter sealant and backing materials in accordance with Section 07 9200.

**3.3 TOLERANCES**

A. Maximum Variation from Level or Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 0.5 inches per 100 ft (12 mm/30 m), whichever is less.

**3.4 ADJUSTING**

A. Adjust hardware for smooth operation and secure weathertight closure.

**3.5 CLEANING**

A. Remove protective material from pre-finished surfaces.

B. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.

C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

**END OF SECTION 08 5313**

**SECTION 08 7100  
DOOR HARDWARE**

**PART 1 - GENERAL**

**1.1 RELATED REQUIREMENTS**

- A. Section 08 0500 - Basic Materials and Methods: Doors and Windows
- B. Section 08 7101- Door Hardware Schedule

**1.2 REFERENCE STANDARDS**

- A. ANSI/ICC A117.1-2009 Accessible and Usable Buildings.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. Builders Hardware Manufacturers Association, Inc.
- D. BHMA A156.1 - American National Standard for Butts and Hinges; Builders Hardware Manufacturers Association, Inc. (ANSI/BHMA A156.1); current edition.
- E. BHMA A156.2 - American National Standard for Bored and Preamsembled Locks & Latches; Builders Hardware Manufacturers Association (ANSI/BHMA A156.2); current edition.
- F. BHMA A156.3 - American National Standard for Exit Devices; Builders Hardware Manufacturers Association (ANSI/BHMA A156.3); current edition.
- G. BHMA A156.4 - American National Standard for Door Controls - Closers; Builders Hardware Manufacturers Association, Inc. (ANSI/BHMA A156.4); current edition.
- H. BHMA A156.7 - American National Standard for Template Hinge Dimensions; Builders Hardware Manufacturers Association (ANSI/BHMA A156.7); current edition.
- I. BHMA A156.8 - American National Standard for Door Controls - Overhead Stops and Holders; Builders Hardware Manufacturers Association, Inc.; (ANSI/BHMA A156.8); current edition.
- J. BHMA A156.13 - American National Standard for Mortise Locks & Latches Series 1000; Builders Hardware Manufacturers Association (ANSI/BHMA A156.13); current edition.
- K. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc. (ANSI/BHMA A156.18); current edition.
- L. BHMA A156.22 - American National Standard for Door Gasketing and Edge Seal Systems, Builders Hardware Manufacturers Association (ANSI/BHMA A156.22); current edition.
- M. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; current edition.
- N. NFPA 101 - Life Safety Code; National Fire Protection Association; current edition.
- O. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the manufacture, fabrication, and installation of products onto which door hardware will be installed.
- B. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- C. Convey Owner's keying requirements to manufacturers.
- D. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by all affected installers.
- E. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

**1.4 SUBMITTALS**

- A. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project.
- B. Samples: Prior to preparation of hardware schedule:
  - 1. Submit 1 sample of hinge, latchset, lockset, and closer illustrating style, color, and finish.
  - 2. Samples will be returned to supplier.
- C. Hardware Schedule: Detailed listing of each item of hardware to be installed on each door. Use door numbering scheme as included in the Contract Documents. Identify electrically operated items and include power requirements.

- D. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

## **1.5 QUALITY ASSURANCE**

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Source Limitation: Provide all items of a single type by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. ANSI/ICC A117.1-2009 Accessible and Usable Buildings.
  - 3. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  - 4. Applicable provisions of NFPA 101, Life Safety Code.
  - 5. Fire-Rated Doors: NFPA 80.
  - 6. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.
  - 7. Hardware for Smoke and Draft Control Doors: Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
- D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.

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

- A. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Design is based on the following hardware products from the Assa Abloy group, except where specified otherwise. Subject to compliance with the design requirements and performance requirements represented by the basis of design selections, products manufactured by companies in the Ingersol Rand and Stanley/Best groups will be acceptable, subject to the Owner's and Architect's evaluation and approval.
- B. Where fire-rated assemblies are required, provide appropriate fire-rated hardware.

### **2.2 BUTT HINGES**

- A. BHMA A156 template-produced 5-knuckle ball bearing butts, 4-1/2 inches x 4-1/2 inches for doors 1-3/4" thick and radiused 3-1/2" x 3-1/2" hinges for doors 1-3/8" thick.
- B. Provide not less than three hinges per leaf for doors up to 7-feet in height.
- C. Provide heavy weight butts for doors exceeding 36 inches in width.
- D. Provide stainless steel with stainless steel pins for exterior and wet areas.
- E. Basis of Design, Ball-Bearing Butts:
  - 1. 1-3/4" Thick Doors: McKinney TA2714 or TA2317(stainless steel w/stainless steel pins).
  - 2. 1-3/8" Thick Doors: McKinney 1458

### **2.3 CONTINUOUS GEARED HINGES**

- A. BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
- B. Application: Aluminum entrance doors.
- C. Basis of Design: Pemko FM Series

### **2.4 CLOSERS**

- A. BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to



weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

- B. Provide closers for all interior doors that are required to be self-closing and other interior doors indicated.
- C. For non-rated interior doors with closers, provide closers with hold-open feature.
- D. Provide exterior rated closers for all door on the exterior of the building.
- E. Basis of Design, Closers:
  - 1. Interior Doors
    - a. Common Areas: Norton 7500
    - b. Apartment Entry Doors: Norton 1700
  - 2. Exterior Doors: Norton 7500
- F. Door Closers for common areas such as Main Entries, Offices, Community Room and Community Kitchen, Common area Restrooms, Laundry, Fitness, Stairs, Trash Rooms and Accessible Unit Entry doors must have the delayed action feature that holds the door open for a mi of 5 seconds.

## **2.5 LOCKS AND LATCHES**

- A. All locks and latches shall be furnished with standard wrought box strikes.
- B. Cylindrical (bored locks) BHMA A156.2; Grade 1, Series 4000.
  - 1. Provide cylindrical locks for interior doors as scheduled.
- C. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000
  - 1. Provide mortise locks for exterior doors.
- D. Trim: Levers shall meet specified accessibility requirements. Elan or Levon.
- E. Lock functions are indicated on the Door and Frame Schedule.
- F. Basis of Design:
  - 1. Exterior Doors: Falcon Mortise Locks
  - 2. Interior Doors, Common Areas: Falcon Cylindrical Locks
  - 3. Apartment Entry Doors: Falcon Interconnected Locks - Passage set with deadbolt with interchangeable core - D 200 series – 6 pin
  - 4. Apartment Interior Doors: Falcon Cylindrical Locks

## **2.6 EXIT DEVICES**

- A. BHMA A156.3. Provide rim devices for single doors; provide exposed vertical rod devices for pairs of doors without center mullions.
- B. Basis of Design: Falcon touchbar exit devices.

## **2.7 PROTECTION PLATES**

- A. BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; bevelled three sides; with manufacturer's standard machine or self-tapping screw fasteners.
- B. NFPA 80 Standards - 6.4.5 Protection Plates 6.4.5.1 - Factory installed protection plates shall be installed in accordance with the listing of the door. 6.4.5.2 - Field installed protection plates shall be labeled and installed in accordance with their listing. 6.4.5.3 - Labeling shall not be required where the top of the protection plate is not more than 16" (406mm) above the bottom of the door.
- C. Basis of Design: Rockwood K1050
  - 1. Provide a 4-inch high mop plate on the interior side of each public toilet room door and common area doors with resilient flooring.
  - 2. Provide a 8-inch high kick plate on the push side of each door equipped with a panic exit device and other doors scheduled.

## **2.8 WALL AND FLOOR-MOUNTED STOPS**

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; aluminum base metal.
- B. Provide convex wall stops for each door leaf unless a floor stop is necessary to protect the door leaf from striking cabinetry or other permanent obstructions within the arc of travel.

- C. Basis of Design:
  - 1. Wall stop: Rockwood 409
  - 2. Floor stop: Rockwood 442

## **2.9 THRESHOLDS**

- A. BHMA A156.21; fabricated to full width of opening indicated.
- B. Basis of Design: Pemko 1665 5-inch aluminum saddle threshold.

## **2.10 GASKETING, WEATHERSTRIPPING, SWEEPS, AND SILENCERS**

- A. Fire and Smoke Gasketing: Intumescent batwing style. self-adhesive
  - 1. Basis of Design: Pemko HSS2000xS44 Smoke Seal
- B. Weatherstripping: Surface-applied silicone bulb
  - 1. Basis of Design: Pemko S88
- C. Door Bottom Sweeps: 1" vinyl sweep with anodized aluminum retainer, surface-applied.
  - 1. Basis of Design: Pemko 307V
- D. Door Silencers: Gray rubber for pre-drilled frame application.
  - 1. Basis of Design: Rockwood 608

## **2.11 AUXILLIARY TRIM**

- A. Door Viewers: BHMA A156.16, forged brass.
  - 1. Door Viewers:
    - a. Basis of Design: Rockwood 662
  - 2. Combination Door Knocker/Viewer:
    - a. Basis of Design: Rockwood 611 with 622 viewer

## **2.12 HARDWARE FINISHES**

- A. Satin Nickle.

## **2.13 KNOX BOX**

- A. Install Knox Box 3200 Series Hinged Door Model flush mounted recessed (6-1/2"h x 6-1/2"w x 5"d) in locations as recommended by Fire Department

## **2.14 LOCK CORES AND KEYING**

- A. Interchangeable lock cores will be furnished by the Owner and installed by the Contractor.
- B. Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
- C. Include construction keying and control keying with removable core cylinders.
- D. Key to existing keying system.
  - 1. Manufacturer's interchangeable core system.
  - 2. Supply keys in the following quantities:
    - a. 4 construction keys.
    - b. 4 control keys and 10 extra cylinder cores.

## **2.15 DOOR HARDWARE - GENERAL**

- A. Provide all hardware specified or required to make doors fully functional, compliant with applicable codes, and secure to the extent indicated.
- B. Source Limitation: Provide all items of a single type by the same manufacturer.
- C. Provide products that comply with the following:
  - 1. Applicable provisions of federal, state, and local codes.
  - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
  - 3. Applicable provisions of NFPA 101, Life Safety Code.
  - 4. Fire-Rated Doors: NFPA 80.
  - 5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.

- 6. Hardware for Smoke and Draft Control Doors: Provide hardware that enables door assembly to comply with air leakage requirements of the applicable code.
- D. Function: Lock and latch function numbers and descriptions of manufactures series as listed in hardware schedule.
- E. Finishes: All door hardware the same finish unless otherwise indicated.
  - 1. Primary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
  - 2. Secondary Finish: Satin chrome plated over nickel on brass or bronze, 626 (approx US26D).
    - a. Use secondary finish in kitchens, bathrooms, and other spaces containing chrome or stainless steel finished appliances, fittings, and equipment; provide primary finish on one side of door and secondary finish on other side if necessary.
  - 3. Finish Definitions: BHMA A156.18.
  - 4. Exceptions:
    - a. Where base metal is specified to be different, provide finish that is an appearance equivalent according to BHMA A156.18.
    - b. Hinges for Fire-Rated Doors: Steel base metal with painted finish.
- F. Fasteners:
  - 1. Mineral Core Wood Doors: Sex bolts.
  - 2. Concrete and Masonry Substrates: Stainless steel machine screws and lead expansion shields.

## 2.16 HINGES

- A. Hinges: Provide hinges on every swinging door.
  - 1. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
  - 2. Provide ball-bearing hinges at all doors having closers.
  - 3. Provide hinges in the quantities indicated.
  - 4. Provide non-removable pins on exterior outswinging doors.
  - 5. Where electrified hardware is mounted in door leaf, provide power transfer hinges.
- B. Butt Hinges: Comply with BHMA A156.1 and A156.7; standard weight, unless otherwise indicated.
  - 1. Provide hinge width required to clear surrounding trim.
- C. Quantity of Hinges Per Door:
  - 1. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
  - 2. Doors 90 inches (2.3 m) High up to 120 inches (3 m) High: Four hinges.

## 2.17 LOCKS AND LATCHES

- A. Locks: Provide a lock for every door, unless specifically indicated as not requiring locking.
  - 1. Hardware Sets indicate locking functions required for each door.
  - 2. If no hardware set is indicated for a swinging door provide an office lockset.
  - 3. Trim: Provide lever handle or pull trim on outside of all locks unless specifically stated to have no outside trim.
  - 4. Lock Cylinders: Provide key access on outside of all locks unless specifically stated to have no locking or no outside trim.
- B. Lock Cylinders: Manufacturer's standard tumbler type, six-pin standard core.
  - 1. Provide cams and/or tailpieces as required for locking devices required.
- C. Keying: Grand master keyed.
  - 1. Key to existing keying system.
- D. Latches: Provide a latch for every door that is not required to lock, unless specifically indicated.

## 2.18 CYLINDRICAL LOCKSETS

- A. Locking Functions: As defined in BHMA A156.2, and as follows:
  - 1. Passage: No locking, always free entry and exit.
  - 2. Privacy: F76, emergency tool unlocks.
  - 3. Office: F81, key not required to lock, remains locked upon exit.
  - 4. Always-Locked: F86, key required to lock, may not be left unlocked.

5. Exit Only: F89, may not be left unlocked.

## **2.19 MORTISE LOCKSETS**

- A. Locking Functions: As defined in BHMA A156.13, and as follows:
  1. Office: F04, key not required to lock, remains locked upon exit.
  2. Entry, Deadbolt: F20, may be locked without key, free egress.
  3. Always-Locked: F07, may not be left unlocked.

## **2.20 EXIT DEVICES**

- A. Locking Functions: Functions as defined in BHMA A156.3, and as follows:
  1. Entry/Exit, Free Swing: Key outside retracts latch, latch holdback (dogging) for free swing during occupied hours, not fire-rated; outside trim must be specified as lever or pull.

## **2.21 CLOSERS**

- A. Closers: Complying with BHMA A156.4.
  1. Provide surface-mounted, door-mounted closers unless otherwise indicated.
  2. Provide a door closer on every exterior door.
  3. Provide a door closer on every fire- and smoke-rated door. Spring hinges are not an acceptable self-closing device unless specifically so indicated.
  4. On pairs of swinging doors, if an overlapping astragal is present, provide coordinator to ensure the leaves close in proper order.

## **2.22 STOPS AND HOLDERS**

- A. Stops: Complying with BHMA A156.8; provide a stop for every swinging door, unless otherwise indicated.
  1. Provide wall stops, unless otherwise indicated.
  2. If wall stops are not practical, due to configuration of room or furnishings, provide overhead stop.
  3. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop unless specifically so stated.

## **2.23 GASKETING AND THRESHOLDS**

- A. Gaskets: Complying with BHMA A156.22.
  1. On each door in smoke partition, provide smoke gaskets; top, sides, and meeting stile of pairs. If fire/smoke partitions are not indicated on drawings, provide smoke gaskets on each door identified as a "smoke door" and 20-minute rated fire doors.
  2. On each exterior door, provide weatherstripping gaskets, unless otherwise indicated; top, sides, and meeting stiles of pairs.
    - a. Where exterior door is also required to have fire or smoke rating, provide gaskets functioning as both smoke and weather seals.
  3. On each exterior door, provide door bottom sweep, unless otherwise indicated.
- B. Thresholds:
  1. At each exterior door, provide a threshold unless otherwise indicated.

## **2.24 PROTECTION PLATES AND ARCHITECTURAL TRIM**

- A. Protection Plates:
  1. Kickplate: Provide on push side of every door with closer, except storefront and all-glass doors.
  2. Mop Plates: Provide on room side of kitchens, toilet rooms

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that doors and frames are ready to receive work; labeled, fire-rated doors and frames are present and properly installed, and dimensions are as indicated on shop drawings.

### **3.2 INSTALLATION**

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item: As listed in Schedule, unless otherwise noted:

### **3.3 ADJUSTING**

- A. Adjust work under provisions of Section 01 7000.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

### **3.4 CLEANING**

- A. Clean adjacent surfaces soiled by hardware installation. Clean finished hardware per manufacturer's instructions after final adjustments has been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### **3.5 PROTECTION**

- A. Protect finished Work under provisions of Section 01 7000.
- B. Do not permit adjacent work to damage hardware or finish.

**END OF SECTION 08 7100**

**SECTION 08 7101  
DOOR HARDWARE SCHEDULE**

**General:** Hardware finish: US 626 or equivalent.

**Set 1**

Doors: Exterior Vestibule - Pr Doors

Qty	Item Description
2	Continuous Hinge
1	Closer
1	Automatic Opener
2	Electrified crash bar with vertical locking pins
2	Pull
1	Dead Bolt
2	Power Supply
2	Door contacts
1	Threshold
2	Sweep
2	Raid drip
2	Weatherstripping

**Set 1A**

Doors: Exterior Vestibule -Single Door

Qty	Item Description
1	Continuous Hinge
1	Closer
1	Crash Bar
1	Pull
1	Dead Bolt
1	Threshold
1	Sweep
1	Rain drip
1	Weatherstripping

**Set 2**

Doors: Interior Vestibule - Pr Doors, Access Control and Automatic Opener

Qty	Item Description
2	Continuous Hinge
1	Closer
1	Automatic Opener
2	Electrified crash bar with vertical locking pins
1	Door access control
2	Pull
1	Dead bolt
1	Power supply
1	Door contact – door C120/2 only (by security company) Automatic Opener
1	Threshold

1	Sweep
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**Set 2A**

Doors: Interior Vestibule- Single Door, Access Control and Automatic Opener

Qty	Item Description
1	Continuous Hinge
1	Closer
1	Automatic Opener
1	Electrified crash bar
1	Door Access control
1	Pull
1	Dead bolt
1	Power supply
1	Wall Stop
1	Threshold

**Set 3**

Doors: Office – Single Door

Qty	Item Description
3	Hinge
1	Closer
1	Bored lock, Office function
1	Wall stop
3	Silencers

**Set 4**

Doors: Exterior Corridor - Single Door

Qty	Item Description
1	Continuous Hinge
1	Exit Device
1	Closer
1	Wall Stop
1	Seals
1	Threshold
1	Sweep

**Set 5**

Doors: Mechanical / Maintenance- Single Door

Qty	Item Description
3	Hinge
1	Storeroom Lockset
1	Wall stop
3	Silencers

**Set 5A**

Doors: Elevator Maintenance – Single Door

Qty	Item Description
3	Hinge
1	Storeroom Lockset

1	Wall stop
3	Silencers

**Set 6**

Doors: Exterior Mechanical / Maintenance – Pr Doors

Qty	Item Description
6	Hinge, non-ferrous
2	Closer
1	Door viewer* in one door only
2	Exit device
1	Storeroom Lockset
2	Lock guard
2	Overhead stop
2	Threshold
2	Sweeps
2	Seals

**Set 6A**

Doors: Exterior Mechanical / Maintenance – Single Door

Qty	Item Description
3	Hinge, non-ferrous
1	Closer
1	Exit device
1	Storeroom Lockset
1	Lock guard
1	Overhead stop
1	Threshold
1	Sweep
1	Seal

**Set 7**

Doors: Storage / Data / Pantry – Pr Doors

Qty	Item Description
6	Hinge
1	Storeroom Lockset
1	Dummy Trim
1	Wall Stops
6	Silencers

**Set 7A**

Doors: Storage- Single Door

Qty	Item Description
3	Hinge
1	Storeroom Lockset
1	Dummy Trim
1	Wall Stops
3	Silencers



**Set 8**

Doors: Laundry / Fitness- Single Door, Access Control

Qty	Item Description
3	Hinge
1	Closer
1	Power Supply
1	Door Access Control
1	Storeroom Lockset
1	Mop plate
3	Silencers

**Set 9**

Doors: Community Room – Pr Doors

Qty	Item Description
6	Hinge
2	Closer
2	Push / Pull
2	Bored lock, classroom function
2	Kick plate
6	Silencers

**Set 9A**

Doors: Community Exterior – Pr Doors

Qty	Item Description
2	Continuous Hinge
1	Closer
1	Door Access Control
2	Electrified crash bar with vertical locking pins
2	Pull
1	Dead Bolt
2	Power Supply
2	Door contacts
1	Threshold
2	Sweep
2	Raid drip
2	Weatherstripping

**Set 10**

Doors: Women &amp; Men Toilet Room – Single Door

Qty	Item Description
3	Hinge
1	Closer
1	Bored lock, privacy function with in use indicator
	Lock needs to be opened from the outside in the event of an emergency
1	Coat hook
1	Wall stop

3	Silencers
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**Set 11**

Doors: Kitchen – Single Door

Qty	Item Description
3	Hinge
1	Office Lockset
1	Wall Stops
3	Silencers

**Set 12**

Doors: Trash Room – Single Door

Qty	Item Description
3	Hinge
1	Passage lockset
1	Wall stop
3	Silencers

**Set 13**

Doors: Interior Stair – Single Door

Qty	Item Description
3	Hinge
1	Passage lockset
1	Wall stop
3	Silencers

**Set 14**

Doors: Exterior Stair -Single Door

Qty	Item Description
3	Hinge
1	Exit Devise
1	No lever on exterior
1	Wall stop
3	Silencers
1	Threshold
1	Sweep
1	Seals

**Set A**

Doors: Unit Entry – Single Door

Qty	Item Description
3	Hinge
1	Closer
1	Passage set
1	Deadbolt with thumb turn and interchangeable core
1	Wall stop
1	Door knocker w/ viewer*
1	Gasketing
1	Door Sweep
1	Threshold
3	Door Silencers

\*Provide additional viewer at Accessible Units

**Set B**

Doors: Unit Bedroom and Bathroom – Single Door

Qty	Item Description
3	Hinge
1	Bored privacy set
1	Hinge stop per door

**Set C**

Doors: Unit Closet, Linen, and Storage – Single Door

Qty	Item Description
3	Hinge, 4" x 4", 5/8" radius corners
1	Bored closet passage (one side)
1	Hinge stop per door

**Set D**

Doors: Utility – Single Door

Qty	Item Description
3	Hinge
1	Closer
1	Bored lock, storeroom function
1	Wall stop
3	Silencers

**END OF SECTION 08 7101**

**SECTION 08 7113  
AUTOMATIC DOOR OPERATORS**

**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 types of automatic door operators:
  - 1. Exterior and interior, automatic door operators, low energy, with concealed header mounting and semi-concealed door arms.
  - 2. Automatic door operators shall be configured for doors as follows:
    - a. Simultaneous pairs.
    - b. Single doors.
- B. Related Sections:
  - 1. Section 08 4313 - "Aluminum-Framed Entrances and Storefronts"
  - 2. Section 08 7100 - "Door Hardware"
  - 3. Division 26 Sections for electrical connections provided separately including conduit and wiring for power to, and control of, automatic door operators.

**1.3 REFERENCES**

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Underwriters Laboratories (UL):
  - 1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- C. American National Standards Institute (ANSI)/Builders' Hardware Manufacturers Association (BHMA):
  - 1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
  - 2. ANSI/BHMA A156.19: Standard for Power Assist and Low Energy Power Operated Doors.
- D. American Society for Testing and Materials (ASTM):
  - 1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. American Association of Automatic Door Manufacturers (AAADM).
- F. National Fire Protection Association (NFPA):
  - 1. NFPA 101 – Life Safety Code.
  - 2. NFPA 70 – National Electric Code.
- G. International Code Council (ICC):
  - 1. IBC: International Building Code.
- H. Building Officials and Code Administrators International (BOCA), 1999.
- I. International Standards Organization (ISO):
  - 1. ISO 9001 - Standard for Manufacturing Quality Management Systems
  - 2. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures
  - 3. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework
  - 4. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines

- 5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services.
- J. National Association of Architectural Metal Manufacturers (NAAMM):
  - 1. Metal Finishes Manual for Architectural and Metal Products.
- K. American Architectural Manufacturers Association (AAMA):
  - 1. AAMA 606.1 – Integral Color Anodic Finishes for Architectural Aluminum.
  - 2. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
- L. United Nations Central Product Classification (UNCPC):
  - 1. UNCPC 4212 - Product Category Rules for Preparing an Environmental Product Declaration for Power-Operated Pedestrian Doors and Revolving Doors

#### 1.4 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.
- B. Knowing act: Consciously initiating the opening of a power operated door using acceptable methods including wall mounted switches such as push plates and controlled access devices such as keypads, card readers and key switches.
- C. Safety Device: Device that prevents a door from opening or closing, as appropriate.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide automatic door operators capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F (Minus 34 deg C) to 130 deg F (54 deg C).
- C. Opening-Force Requirements for Egress Doors: In the event power failure to the operator, swinging automatic entrance doors shall open with a manual force, not to exceed 30 lbf (133 N) to set door in motion, and not more than 15 lbf to fully open the door. Forces shall be applied at 1" (25 mm) from the latch edge of the door.

#### 1.6 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 01 submittal procedures.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work. Indicate wiring for electrical supply.
- C. Color Samples for selection of factory-applied color finishes.
- D. Closeout Submittals: Provide the following with project close-out documents.
  - 1. Owner's Manual.
  - 2. Warranties.
- E. Reports: Based on evaluation performed by a qualified agency, for automatic door operators.
  - 1. Environmental Product Declaration.
  - 2. Evaluation Report for compliance with IBC.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility certified under ISO 9001.
- C. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- D. Certifications: Automatic door operators shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
  - 1. ANSI/BHMA A156.10 and A156.19.
  - 2. NFPA 101.
  - 3. UL 325 Listed.
  - 4. IBC 2018.
  - 5. BOCA.

- E. Environmental Product Declaration (EPD): EPD for automatic door operators shall be certified by the manufacturer to comply with the following:
  - 1. Prepared under Product Category Rule (PCR) UNCPC 4212.
  - 2. Conform to ISO standards 14025, 14040, 14044, 21930
  - 3. Life Cycle Assessment Basis: Cradle to Gate, minimum.
- F. Source Limitations: Obtain automatic door operators through one source from a single manufacturer.
- G. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- H. Power Operated Door Standard: ANSI/BHMA A156.19.
- I. 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.
- J. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

### **1.8 PROJECT CONDITIONS**

- A. Field Measurements: General Contractor shall verify openings to receive automatic door operators by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor Advise of any inadequate conditions or equipment.

### **1.9 COORDINATION**

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to, power supplies, remote activation devices, and electric door latching hardware.
- C. System Integration: Integrate automatic door operators with other systems as required for a complete working installation. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.

### **1.10 WARRANTY**

- A. Automatic door operators shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.
- C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

## **PART 2 - PRODUCTS**

### **2.1 AUTOMATIC DOOR OPERATORS**

- A. Manufacturer: Basis of Design: Stanley Access Technologies; M-Force™ Series automatic door operator with Swing-Guard® door mounted safety system.  
Substitutions: Section 01 3000 Administrative Requirements.

### **2.2 MATERIALS**

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Headers: 6063-T6.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Sheet and Plate: ASTM B 209.

### 2.3 COMPONENTS

- A. Header Case: Header case shall not exceed 6" (152 mm) square in section and shall be fabricated from extruded aluminum with structurally integrated end caps, designed to conceal door operators and controls. The operator shall be sealed against dust, dirt, and corrosion within the header case. Access to the operator and electronic control box shall be provided by a full-length removable cover, edge rabbetted to the header to ensure a flush fit. Removable cover shall be secured to prevent unauthorized access.
- B. Semi-Concealed Door Arms: A combination of door arms and track shall provide positive control of door through entire swing; units shall permit use of butt hung, and offset pivot-hung doors. Semi-concealed door arms shall be designed for partial concealment and shall not be readily visible with door in closed position.
- C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.  
Signage: Provide signage in accordance with ANSI/BHMA A156.19.

### 2.4 SWINGING DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.
- B. Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
  1. Operation: Power opening and spring closing.
  2. Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
  3. Handing: Non-handed; no tools required to change handing.
  4. Capacity: Rated for door panels weighing up to 700 lb (318 kg).
  5. Mounting: Concealed.
  6. Features:
    - a. Adjustable opening and closing speeds.
    - b. Adjustable opening and closing force.
    - c. Adjustable back-check.
    - d. Adjustable hold-open time between 0 and 30 seconds.
    - e. Reverse on obstruction.
    - f. Time delay for electric lock integration.
    - g. Force compensation and closed loop speed control with active braking and acceleration.
    - h. Power Close.
    - i. Slam Protection.
    - j. Power Assist.
    - k. Lock Release.
    - l. Stall Sensor Ignore.
    - m. Electronic Coordination.
    - n. Optional Switch to open/Switch to close operation.
    - o. Optional push to activate operation.
    - p. Fire alarm interface, configurable to safely open or close doors on signal from fire alarm system.
- C. Field Adjustable Spring Closing Operation: The operator shall close the door by spring energy employing the motor, as a dynamic brake to provide closing speed control. The closing spring shall be a helical compression spring, adjustable for positive closing action. The spring shall be adjustable, without removing the operator from the header, to accommodate a wide range of field conditions.

- D. Independent Adjustable Closing and Latching Speed Control: The operator shall employ a rheostat module to allow for independent field adjustment of closing and latching speeds using the motor as a dynamic brake.
- E. Field Adjustable Open Stop: The operator shall provide a field adjustable open stop to accommodate opening angles from 80 to 135 degrees without the need for additional components.
- F. Consistent Cycle: The operator shall deliver an even, consistent open manual push force across the entire transition from door fully closed to door fully open. Additionally, the force shall be field adjustable to accommodate a wide range of on-site conditions.
- G. Quiet Performance: The operator shall be designed to output audible noise ratios less than or equal to 50dba.
- H. Manual Use: The operator shall function as a manual door closer in the direction of swing with or without electrical power. The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open.
- I. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.

## 2.5 ELECTRICAL CONTROLS

- A. Electrical Control System: Electrical control system shall include a microprocessor controller and a high-resolution position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position and speed.
  - 1. The high-resolution encoder shall have a resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
  - 2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
- B. Performance Data: The microprocessor shall collect, and store performance data as follows:
  - 1. Counter: A non-resettable counter to track operating cycles.
  - 2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
- C. LED Display: Display presenting the current operating state of the controller.  
 Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
  - 1. Automatic Reset Upon Power Up.
  - 2. Main Fuse Protection.
  - 3. Electronic Surge Protection.
  - 4. Internal Power Supply Protection.
  - 5. Resettable sensor supply fuse protection.
- D. Motor Protection, over-current protection.  
 Power Close: When enabled, engages the operator to close a door that does not close completely at the end of a cycle.
- E. Force Compensation: Utilizing the closed loop speed control, the operator shall maintain constant opening and closing speeds when subjected to excessive outside forces, such as positive or negative stack pressures.
- F. Slam Protection: The operators speed control system prevents door from slamming at the full open or full closed position.
- G. Power Assist: Operator mode that lowers opening forces when the door is used manually. Power assist is active only while pushing or pulling the door. The door will close when an opening force is no longer applied.
- H. Lock Release: On doors with electric locking, operator shall include a closing function to release tension on a latch mechanism prior to opening the door.
- I. Stall Sensor Ignore: Adjustable setting to disable swing side safety sensors at a specific angle.  
 Electronic Coordination: On pairs of doors, allows independent timing of opening and closing of each leaf as required for astragal coordination.
- J. Soft Start/Stop: A "soft-start" "soft-stop" motor driving circuit shall be provided for smooth normal opening and recycling.



- K. Obstruction Recycle: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle.
- L. Programmable Controller: Microprocessor controller shall be field programmable.
  - 1. The following parameters may be adjusted:
    - a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
    - b. Adjustable and variable features specified.
  - 2. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.
- M. Emergency Breakout Switch: A cam actuated emergency breakout switch shall be provided to disconnect power to the motor when an in-swinging door is manually pushed in the emergency out direction. The operator will then automatically reset, and power will be resumed.
- N. Control Switch: Automatic door operators shall be equipped with a three-position function switch to control the operation of the door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.
- O. Power Switch: Automatic door operators shall be equipped with a two position On/Off switch to control power to the door.

## 2.6 ACTIVATION AND SAFETY DEVICES

- A. Touchless Activation Switch: Provide touchless activation switches for activation of automatic door operators. Face plates shall be engraved with waving hand logo and "Wave To Open" text.
  - 1. Switches shall be wall mounted in single gang electrical boxes and hardwired to door operator controls.
  - 2. Units shall incorporate microwave frequency to detect all motion in the detection zone. Detection zone shall be adjustable from 4 inch to 24 inch (51 mm to 610 mm).
  - 3. LED indicator for activation confirmation.
  - 4. Relay shall be rated at 1 A at 60 VDC.
  - 5. Relay hold time adjustable from 0.5 to 30 sec.
  - 6. IP55 rated enclosure.
  - 7. Touchless activation switches shall be equal to or better than BEA MS31.
- B. Presence Detection: Provide presence detection system designed to sense people in the swing zone when the swinging automatic entrance door is fully open, fully closed or in motion. System provided shall consist of door mounted safety sensors and accessories required for a complete working system as follows:
  - 1. Door Mounted Presence Detection Sensors: Door mounted presence detection sensors shall be reflective active infrared type designed specifically to sense moving or stationary objects in the swing zone on each side of a moving door leaf. Sensor housings shall be high impact shock resistant with tinted lenses suitable for door mounting. Door mounted presence detection sensors shall not be affected by ultrasonic, ambient light or radio frequencies, within the vicinity of the swing door.
  - 2. Secondary Activation: Presence detection system shall satisfy the requirements for secondary activation; no additional sensors shall be required.
  - 3. Supporting relays and controllers shall be provided for a complete working system.
  - 4. Door mounted presence detection sensors shall be equal to or better than Stanley Access Technologies Swing-Guard.

## 2.7 ALUMINUM FINISHES

- A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.
- B. Class I, Color Anodic Finish: AA-M12C22A42/A44 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.70 mils minimum complying with AAMA 611-98, and the following:
  - 1. Color: Dark Bronze.
  - 2. AAMA 606.1

3. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of swinging automatic entrance doors. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. General: Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Mounting: Install automatic door operators/headers plumb and true in alignment with established lines and grades. Anchor securely in place.
  1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
  2. Set headers, arms and linkages level and true to location with anchorage for permanent support.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

#### **3.3 FIELD QUALITY CONTROL**

- A. Testing Services: Factory Trained Installer shall test and inspect each swinging automatic entrance door to determine compliance of installed systems with applicable ANSI standards.

#### **3.4 ADJUSTING**

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.19 by AAADM Certified Technician.

#### **3.5 CLEANING AND PROTECTION**

- A. Clean surfaces promptly after installation. Remove excess sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

**END OF SECTION 08 7113**

**SECTION 08 8000  
GLAZING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Glass.
- B. Glazing compounds and accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 07 9200 - Joint Sealants
- B. Section 08 0500 - Basic Materials and Methods: Openings

**1.3 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C 864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; current edition.
- C. ASTM C 1036 - Standard Specification for Flat Glass; current edition.
- D. ASTM C 1048 - Standard Specification for Heat-Treated Flat Glass--Kind HS, Kind FT Coated and Uncoated Glass; current edition.
- E. ASTM C 1172 - Standard Specification for Laminated Architectural Flat Glass; current edition.
- F. ASTM C 1193 - Standard Guide for Use of Joint Sealants; current edition.
- G. ASTM E 1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; current edition.
- H. ASTM E 2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; current edition.
- I. GANA (GM) - GANA Glazing Manual; Glass Association of North America; current edition.
- J. GANA (SM) - FGMA Sealant Manual; Glass Association of North America; current edition.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

**1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

**1.6 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

**1.7 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

**PART 2 - PRODUCTS**

**2.1 GLAZING TYPES**

- A. Sealed Insulating Glass Units: Vision glazing, low-E.
  - 1. Application(s): All exterior glazing unless otherwise indicated.
  - 2. Between-lite space filled with air.
  - 3. Thermal Resistance (U-Value): 0.28, nominal.

4. Total Solar Heat Gain Coefficient: 0.50, maximum.
  5. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
  6. Inboard Lite: Annealed float glass, 1/4 inch thick.
  7. Total Thickness: 1 inch.
- B. Single Vision Glazing:
1. Applications: All interior glazing unless otherwise indicated.
  2. Type: Annealed float glass.
  3. Tint: Clear.
  4. Thickness: 1/4 inch.
  5. Glazing Method: Gasket glazing.
- C. Fire-Rated Safety Glazing:
1. Applications: Provide this type of glazing in the following locations:
    - a. Glazed lites in fire doors.
    - b. Sidelights, borrow lites, and other glazed openings in partitions indicated as having an hourly fire rating.
    - c. Other locations indicated on the drawings.
  2. Fire Rating: As indicated on the drawings.
  3. Type: Laminated wired glass.
  4. Thickness: 1/4 inch.
- D. Single Safety Glazing: Non-fire-rated.
1. Applications: Provide this type of glazing in the following locations:
    - a. Glazed lites in doors, except fire doors.
    - b. Sliding glass doors.
    - c. Glazed sidelights to doors, except in fire-rated walls and partitions.
    - d. Other locations required by applicable federal, state, and local codes and regulations.
    - e. Other locations indicated on the drawings.
  2. Type: Fully tempered float glass as specified.
  3. Tint: Clear.
  4. Thickness: 1/4 inch.

## 2.2 EXTERIOR GLAZING ASSEMBLIES

- A. Structural Design Criteria: Select type and thickness to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with ASCE 7.
1. Use the procedure specified in ASTM E 1300 to determine glass type and thickness.
  2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
  3. Thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
1. In conjunction with vapor retarder and joint sealer materials described in other sections.
  2. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

## 2.3 GLASS MATERIALS

- A. Float Glass: All glazing is to be float glass unless otherwise indicated.
1. Annealed Type: ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
  2. Heat-Strengthened and Fully Tempered Types: ASTM C 1048.
  3. Tinted Types: Color and performance characteristics as indicated.
  4. Thicknesses: As indicated; for exterior glazing comply with specified requirements for wind load design regardless of specified thickness.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C 1172.
1. Laminated Safety Glass: Comply with 16 CFR 1201 test requirements for Category II.
  2. Plastic Interlayer: 0.060 inch thick, minimum.

3. Where fully tempered is specified or required, provide glass that has been tempered by the tong-less horizontal method.
- C. Laminated Wired Glass: UL- or WH-listed as fire-protection-rated glazing and complying with 16 CFR 1201 test requirements for Category II with or without the use of a surface-applied film.

## **2.4 SEALED INSULATING GLASS UNITS**

- A. Sealed Insulating Glass Units: Types as indicated.
  1. Locations: Exterior, except as otherwise indicated.
  2. Durability: Certified by an independent testing agency to comply with ASTM E 2190.
  3. Edge Spacers: Aluminum, bent and soldered corners.
  4. Edge Seal: Glass to elastomer with supplementary silicone sealant.
  5. Purge interpane space with dry hermetic air.

## **2.5 GLAZING COMPOUNDS**

- A. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; grey color.

## **2.6 GLAZING ACCESSORIES**

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C 864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C 864 Option I; Black color.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

### **3.2 PREPARATION**

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with ASTM C 1193 and FGMA Sealant Manual.
- E. Install sealant in accordance with manufacturer's instructions.

### **3.3 INSTALLATION - EXTERIOR/INTERIOR DRY METHOD (GASKET GLAZING)**

- A. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### **3.4 MANUFACTURER'S FIELD SERVICES**

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

### **3.5 CLEANING**

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

**END OF SECTION 08 8000**

**SECTION 08 9100  
LOUVERS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Gable vents (Decorative)
- B. Transfer grilles for ventilating furnace rooms in apartment units.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 0500 - Common Work Results for Openings

**1.3 REFERENCE STANDARDS**

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; current edition.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blankout areas required, and frames.
- C. Samples: Submit two samples 2 by 2 inches (50 by 50 mm) in size illustrating finish and color of exterior and interior surfaces.
- D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis of Design: Gable Vents: Dinesol Plastics, Division of Tapco Industries.
- B. Basis of Design: Transfer Grilles: Price Industries STG series.

**2.2 GABLE VENTS**

- A. Factory fabricated and assembled, complete with frame, mullions, and accessories.
  - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf (1.2 kPa) without damage or permanent deformation.
  - 2. Intake Louvers: Design to allow maximum of 0.01 oz/sq ft (3.1 g/sq m) water penetration at calculated intake design velocity based on design air flow and actual free area, when tested in accordance with AMCA 500-L.
  - 3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
  - 4. Screens: Provide insect screens.

**2.3 TRANSFER GRILLES**

- A. Sightproof steel louvers in sizes indicated on Drawings with flat border, powder-coated, color selected by the Architect from manufacturer's full line.

**2.4 MATERIALS**

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, powder coat finish.
- B. Insect Screen: 18 x 16 size aluminum mesh.

**2.5 ACCESSORIES**

- A. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

### **3.2 INSTALLATION**

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.

### **3.3 CLEANING**

- A. Clean surfaces and components.

**END OF SECTION 08 9100**

**SECTION 09 0500  
COMMON WORK RESULTS FOR FINISHES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes general requirements for performance of finishes work in accordance with the Contract Documents.

**1.3 SUSTAINABLE DESIGN REQUIREMENTS**

- A. Sustainable Design Submittals: Refer to Section 01 8113 – Sustainable Design Requirements for the following:
  - 1. Recycled content
  - 2. Regional materials.
- B. VOC Content of Coatings and Sealants: Refer to Section 01 6116 – Volatile Organic Content Restrictions.

**1.4 REFERENCES**

- A. General: Section 01 4200 – “Reference Standards.”
- B. Comply with applicable provisions of standards referenced, edition in effect as of date of Contract, unless more stringent requirements are required by governing codes, laws, and ordinances, or other Specification Sections.

**1.5 SUBMITTALS**

- A. General: Refer to Section 01 3000 – “Administrative Requirements”: For Submittal requirements.
- B. Samples: Submit samples in accordance with requirements of each Section. Submit in sufficient size and quantity to demonstrate normal variations in color and texture, and as follows:
  - 1. Samples for Selection Purposes.
  - 2. Samples for Verification Purposes.
  - 3. Samples to demonstrate proper matching characteristics.
- C. Maintenance Instructions for installed products: Submit at Contract closeout.

**1.6 QUALITY REQUIREMENTS**

- A. Source Limitations: Ensure that each type of product is produced by a single manufacturer and obtained through distribution sources authorized by the manufacturer of each product required, unless otherwise approved by the Architect.
- B. Representative Construction: Construct mock-ups and field samples in accordance with the requirements of applicable Sections.

**PART 2 - PRODUCTS**

**2.1 PRODUCTS, GENERAL**

- A. Refer to Section 01 6000 – Product Requirements.

**PART 3 - EXECUTION**

**3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution Requirements.

**3.2 EXAMINATION**

- A. Review the condition of the area of installation and verify that it is acceptable in accordance with the product manufacturer’s instructions, referenced standards, and accepted trade



practices. Report unfavorable conditions in writing to the Architect. Do not allow installation to proceed until all unsatisfactory conditions have been corrected. Commencing work in an area will be considered acceptance of the existing conditions by that Installer and the Contractor shall assume all responsibility therefore.

- B. Test substrates in accordance with specified testing procedures specified in subsequent Sections and as recommended by manufacturers.

### **3.3 PREPARATION**

- A. Prepare materials for installation in accordance with referenced industry standards, manufacturer's instructions, and accepted trade practices. In exposed or finish work, mix or arrange materials for uniform blending and optimum arrangement according to the Architect's instructions.
- B. Lay out work in advance to ensure accurate spacing of surface patterns with uniform joint thicknesses and for accurate location of openings, joints, returns, and offsets.
- C. Furnish items to be installed or built into work performed by other trades according to the project schedule so as not to cause delays.
- D. Surface Preparation for New Construction:
  - 1. Furnish, install, maintain, and remove as required all necessary temporary protections to safeguard persons and property in the vicinity of the surface preparation area prior to commencement of surface preparation procedures, including but not limited to protection of HVAC system and existing adjacent construction.
  - 2. Prepare surfaces to receive work in accordance with manufacturer's instructions, referenced standards and accepted trade practices.
  - 3. Test substrates according to standard industry practices approved by the manufacturer of the components to be installed. Perform additional testing as recommended by the manufacturer.

### **3.4 EXECUTION, GENERAL**

- A. All work identified in the Contract Documents shall be performed by skilled and, where applicable, by licensed installers. Where indicated in the Contract Documents, installers shall be approved by the manufacturer for installing the materials in the manner indicated.
- B. The Work shall be installed, applied, or erected in accordance with recognized trade practices, unless more stringent installation requirements are described in the Contract Documents or in the approved manufacturer's published installation instructions. For materials or systems that are specified to receive warranties, work shall comply with the requirements of the manufacturer.
- C. Perform all cutting and patching required for full execution of the work. Patching of finished materials shall be performed by skilled installers in a manner that fully restores the finished work to a condition acceptable to the Architect.
- D. Construct work to the full elevations, widths, and thicknesses shown.

### **3.5 INSPECTION**

- A. When required by authorities having jurisdiction over the Project, the Contractor shall schedule and oversee inspections and testing of the installed work and respond to all recommendations that arise therefrom.
- B. When review and inspection of work by a manufacturer representative is a condition of a special project warranty, the Contractor shall schedule and oversee such reviews and inspections and respond to all recommendations that arise therefrom.

### **3.6 CLEANING**

- A. Progress Cleaning: As the Work progresses, the Contractor shall ensure that installed products are cleaned in accordance with the recommendations of the product manufacturer, referenced standards, and accepted trade practices.

### **3.7 FINISHING**

- A. Finish surfaces of installed work that are not pre-finished by the manufacturer or fabricator, including but not limited to metal, wood, and cementitious elements.
  - 1. Finishing includes, as applicable, sealing joints between frames and substrates, surface preparation, priming and painting or staining and sealing in accordance with the manufacturer's recommendations and the Owner's finish scheme.
  - 2. Final color and sheen will be selected by the Architect.
  - 3. Do not conceal or paint over labels or tags required by authorities having jurisdiction when performing finish work.
  - 4. Refer to Section 09 9000 for additional finishing requirements.
- B. Back-prime and weather-proof components installed as part of building shell construction.

### **3.8 PROTECTION**

- A. Provide necessary protections to ensure that installed products are without damage or undue deterioration as of the Project Completion Date. Upon final acceptance of the work, the remove temporary protections from the Project Site.

**END OF SECTION 09 0500**

**SECTION 09 0561  
COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
  - 1. Luxury vinyl tile and plank.
  - 2. Carpet tile.
  - 3. Thin-set ceramic tile.
- B. Preparation of existing concrete floor slabs for installation of floor coverings.
  - 1. Testing of concrete floor slabs for moisture and pH.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 0500 - Common Work Results for Finishes

**1.3 REFERENCES**

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- C. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

**1.4 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

**1.5 SUBMITTALS**

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and pH limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report: Include:
  - 1. Description of areas tested; include floor plans and photographs if helpful.
  - 2. Summary of conditions encountered.
  - 3. Moisture and pH test reports.
  - 4. Copies of specified test methods.
  - 5. Recommendations for remediation of unsatisfactory surfaces.
  - 6. Submit report to Architect.
  - 7. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Copy of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.
- F. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
  - 1. Manufacturer's qualification statement.
  - 2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
  - 3. Manufacturer's installation instructions.
  - 4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

## 1.6 QUALITY ASSURANCE

- A. Moisture and pH testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
  - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
  - 1. Provide access for and cooperate with testing agency.
  - 2. Confirm date of start of testing at least 10 days prior to actual start.
  - 3. Allow at least 4 business days on site for testing agency activities.
  - 4. Achieve and maintain specified ambient conditions.
  - 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

## 1.7 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
  - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of pH found, and suitable for adhesion of flooring without further treatment.
  - 1. Thickness: 1/8 inch (3 mm), maximum.
  - 2. If testing agency recommends any particular products, use one of those.

## PART 3 - EXECUTION

### 3.1 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
  - 1. Preliminary cleaning.
  - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
  - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 4. pH tests; in same locations as moisture vapor emission tests, unless otherwise indicated.

5. Specified remediation, if required.
  6. Patching, smoothing, and leveling, as required.
  7. Other preparation specified.
  8. Adhesive bond and compatibility test.
  9. Protection.
- B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
  2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
  3. Excessive pH: If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### 3.2 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### 3.3 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

### 3.4 PH TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Note: This procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range pH paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch (25 mm) in diameter. Allow the puddle to set for approximately 60 seconds, then dip the pH paper into the water, remove it, and compare immediately to chart to determine pH reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value is over 10.

### 3.5 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

**3.6 APPLICATION OF REMEDIAL FLOOR COATING**

A. Comply with requirements and recommendations of coating manufacturer.

**3.7 PROTECTION**

A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION 09 0561**

**SECTION 09 2116  
GYPSUM BOARD ASSEMBLIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Performance criteria for gypsum board assemblies.
- B. Cementitious backing board.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.
- E. Textured finish system.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 1000 - Rough Carpentry: Building framing and sheathing.
- C. Section 06 1000 - Rough Carpentry: Framing, concealed blocking, and related requirements.
- D. Section 07 2100 - Thermal and Acoustic Insulation: Acoustic insulation.
- E. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.
- F. Section 09 0500 - Common Work Results for Finishes

**1.3 REFERENCE STANDARDS**

- A. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; current edition.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; current edition.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; current edition.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; current edition.
- E. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; current edition.
- F. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; current edition.
- G. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cement Substrate Sheets; current edition.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; current edition.
- I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; current edition.
- J. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; current edition.

**1.4 SUBMITTALS FOR REVIEW**

- A. Product data for gypsum products and accessories specified.

**1.5 SUBMITTALS FOR INFORMATION**

- A. Laboratory Test Reports: For adhesives used to laminate gypsum board panels to substrates, 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."

**1.6 QUALITY ASSURANCE**

- A. Source Limitations: Provide products manufactured within the United States from materials free of sulfur, formaldehyde or other deleterious chemicals. Natural gypsum ore shall be mined in North America. Synthetic (Byproduct) gypsum shall be pure calcium sulfate from domestic sources.

## **PART 2 - PRODUCTS**

### **2.1 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### **2.2 PANEL MATERIALS**

- A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
  - 2. Thickness: As indicated on drawings.
- B. Moisture- and Mold-Resistant Gypsum Board: (Paperless board or equivalent. ASTM C 1396/C 1396M).
  - 1. Application: All rooms containing plumbing fixtures and laundry equipment.
- C. Cement Backing Board:
  - 1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  - 2. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
    - a. Thickness: 1/2 inch (12.7 mm).
  - 3. Application: For ceramic tile substrate.
- D. Ceiling Board: Special sag-resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
  - 1. Thickness: As indicated on drawings.
  - 2. Edges: Tapered.

### **2.3 ACCESSORIES**

- A. Acoustic Insulation: As specified in Section 07 2100.
- B. Acoustic Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless otherwise indicated.
  - 1. Types: As detailed or required for finished appearance.
  - 2. Special Shapes: In addition to conventional cornerbead and control joints, provide U-bead at exposed panel edges.
- D. Joint Materials: ASTM C475.
  - 1. Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
  - 2. Chemical hardening type compound.
- E. High Build Drywall Surfacer (Skimcoat): Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
- F. Textured Finish Materials: Latex-based compound; plain.
- G. Screws for Attachment to Steel Members Less Than 0.03 inch (0.7 mm) In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.



### **3.2 ACOUSTIC ACCESSORIES INSTALLATION**

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

### **3.3 BOARD INSTALLATION**

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

### **3.4 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials and as indicated.

### **3.5 JOINT TREATMENT**

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).
- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

### **3.6 DRYWALL CEILINGS**

- A. Provide knock down textured finish for apartment ceilings except bathrooms.
- B. Provide smooth finish for all common areas and apartment unit bathrooms.

**END OF SECTION 09 2116**

**SECTION 09 3000  
TILING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile base
- C. Tile for wall applications.
- D. Cementitious backer board as tile substrate.
- E. Tile accessories.
- F. Tile trim.
- G. Non-ceramic trim.

**1.2 REFERENCE STANDARDS**

- A. ANSI A108 Series/A118 Series/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); current edition.
  - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; current edition.
  - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar; current edition.
  - 3. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; current edition.
  - 4. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; current edition.
  - 5. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; current edition.
  - 6. ANSI A108.11 - American National Standard for Interior Installation of Cementitious Backer Units; current edition.
  - 7. ANSI A118.1 - American National Standard Specifications for Dry-Set Portland Cement Mortar; current edition.
  - 8. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; current edition.
  - 9. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; current edition.
  - 10. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; current edition.
- B. TCA (HB) - Handbook for Ceramic Tile Installation; Tile Council of North America, Inc.; current edition.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

**1.4 SUBMITTALS**

- A. See Section 01 3300 Submittal Procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 30 x 60 inches in size illustrating pattern, color variations, and grout joint size variations.

- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Tile: 10 square feet of each size, color, and surface finish combination.

### **1.5 QUALITY ASSURANCE**

- A. Maintain one copy of TCA Handbook and ANSI A108 Series/A118 Series on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing tile installation, with minimum of 5 years of documented experience.

### **1.6 MOCK-UP**

- A. See Section 01 4000 - Quality Requirements.
- B. Construct tile mock-up as agreed upon with Owner's Rep. and Architects, incorporating all components specified for the location.
  - 1. Minimum size of mock-up is indicated as stated above.
  - 2. Approved mock-up may remain as part of the Work.

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

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

### **1.8 FIELD CONDITIONS**

- A. Do not install adhesives in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

## **PART 2 - PRODUCTS**

### **2.1 TILE and BASE**

- A. Manufacturers: See finish schedule

### **2.2 TRIM AND ACCESSORIES**

- A. Tile Accessories: Unglazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Tile Trim: Matching bullnose and cove ceramic shapes in sizes coordinated with field tile.
  - 1. Applications: Use in the following locations:
    - a. Open Edges: Bullnose.
    - b. Inside Corners: Jointed.
    - c. Floor to Wall Joints: Cove base.
  - 2. Manufacturer: Same as for tile.
- C. Non-Tile Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
  - 1. Applications: Use in the following locations:
    - a. Open edges of wall tile.
    - b. Open edges of floor tile.
    - c. Transition between floor finishes of different heights.
    - d. Thresholds at door openings.
    - e. Expansion and control joints, floor and wall.

### **2.3 MORTAR MATERIALS**

- A. Manufacturers:
  - 1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  - 2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  - 3. Laticrete International Inc.
  - 4. Atlas Mineral & Chemical Inc

- B. Mortar Bed Materials: Portland cement, sand and water.
- C. Mortar Bond Coat Materials:
  1. Dry-Set Portland Cement type: ANSI A118.1.
  2. Epoxy: ANSI A118.3.

## 2.4 GROUT MATERIALS

- A. Manufacturers:
  1. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com).
  2. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
  3. Laticrete International Inc.
  4. Atlas Mineral & Chemical Inc
- B. Standard Grout: Standard sanded epoxy cement grout, as specified in ANSI A118.6.
  1. Colors: To be selected by Architect from manufacturer's standard range.

## 2.5 ACCESSORY MATERIALS

- A. Mesh Tape: 2-inch wide self-adhesive fiberglass mesh tape.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
  1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours.
  2. Alkalinity: pH range of 5-9.

### 3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

### 3.3 INSTALLATION - GENERAL

- A. Install tile and grout in accordance with applicable requirements of ANSI A108.1 through A108.13, manufacturer's instructions, and TCA Handbook recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- I. Allow tile to set for a minimum of 48 hours prior to grouting.
- J. Grout tile joints. Use standard grout unless otherwise indicated.
- K. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

### 3.4 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCA Handbook Method F111, with cleavage membrane, unless otherwise indicated.

1. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F132, bonded.
- B. Cleavage Membrane: Lap edges and ends.
- C. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

### **3.5 INSTALLATION - WALL TILE**

- A. Over gypsum wallboard on wood or metal studs install in accordance with TCA Handbook Method, unless otherwise indicated.

### **3.6 CLEANING**

- A. Clean tile and grout surfaces.

### **3.7 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

### **3.8 SCHEDULE**

- A. See the drawings for the location and pattern of the tile.
- B. The architect will select tile (multiple colors) from the manufacturer's standard range.

**END OF SECTION 09 3000**

**SECTION 09 6500  
RESILIENT FLOORING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Resilient flooring.
- B. Resilient base.
- C. Installation accessories.

**1.2 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- C. Section 06 2000 - Finish Carpentry (Composite wood base)
- D. Section 09 0500 - Common Work Results for Finishes
- E. Section 09 0561 - Common Work Results for Flooring Preparation

**1.3 REFERENCE STANDARDS**

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; current edition.
- B. C. ASTM F1861 - Standard Specification for Resilient Wall Base; current edition.
- D. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; [www.baaqmd.gov](http://www.baaqmd.gov); current edition.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; current edition.
- F. RFCI - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; current edition.
- G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition; [www.aqmd.gov](http://www.aqmd.gov).
- H. SCS (CPD) - SCS Certified Products; Scientific Certification Systems; current listings at [www.scs-certified.com](http://www.scs-certified.com).

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Flooring Material: 100 square feet of each type and color.
  - 2. Extra Wall Base: 50 linear feet of each type and color.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect roll materials from damage by storing properly.

**1.6 FIELD CONDITIONS**

- A. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F (21 degrees C) to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F (13 degrees C).
- C. Do not install tiles over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, are dry from site conditions, and have pH range recommended by flooring manufacturer. No condensation on underside of 4 foot by 4 foot polyethylene sheet within 48 hours, fully taped at perimeters. PH and moisture rates:

1. PH range of 5 to 9.
  2. Moisture emission rate of 3 lb./1000 sq.ft. per 24 hours or less.
- D. Provide an above slab Vapor Barrier to areas as noted on drawings. Refer to Section 2.05 for testing and installation requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS AND PRODUCTS**

- A. Refer to the Finish Legend for selected products.

### **2.2 RESILIENT FLOORING**

- A. General: All flooring shall comply with the following:
1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  2. VOC Content: Certified as Low Emission by one of the following:
    - a. SCS Floorscore; [www.scs-certified.com](http://www.scs-certified.com).
    - b. Product listing in the CHPS Low-Emitting Materials Product List at; [www.chps.net/manual/lem\\_table.htm](http://www.chps.net/manual/lem_table.htm).
- B. Vinyl Laminate Tile and Plank: PVC tile and plank flooring in 2.5mm thickness., min. 20mil clear PVC wear layer with a polyurethane surface treatment.

### **2.3 RESILIENT BASE**

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove, and as follows:
1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
  2. Height: 4 inch
  3. Thickness: 0.125 inch (3.2 mm) thick.
  4. Finish: Matte.
  5. Length: Roll.
  6. Color: See finish schedule.
  7. Accessories: Premolded external corners and end stops.

### **2.4 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seaming Materials: Waterproof; types recommended by flooring manufacturer.
1. Provide only products having lower volatile organic compound (VOC) content than required by the more stringent of the South Coast Air Quality Management District Rule No.1168 and the Bay Area Air Quality Management District Regulation 8, Rule 51.
- C. Moldings, Transition and Edge Strips: Same material as flooring.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710;

obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

### **3.2 PREPARATION**

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is cured.
- E. Clean substrate.

### **3.3 INSTALLATION**

- A. Where vapor barrier is being installed over the concrete slabs, sheet and tile flooring shall be installed per manufacturer's recommendations for float installation. See drawings for locations.
- B. Starting installation constitutes acceptance of sub-floor conditions.
- C. Install in accordance with manufacturer's instructions.
- D. Spread only enough adhesive to permit installation of materials before initial set.
- E. Fit joints tightly.
- F. Set flooring in place, press with heavy roller to attain full adhesion.
- G. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- H. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
  - 2. Resilient Strips: Attach to substrate using adhesive.
- I. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

### **3.4 TILE FLOORING**

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless manufacturer's instructions say otherwise.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- C. Install tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

### **3.5 RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

### **3.6 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's instructions.

### **3.7 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. Do not allow rolling carts to be used on the floor for at least 72 hours.

**END OF SECTION 09 6500**



**SECTION 09 6813  
TILE CARPETING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Walk-Off Carpet Tile.

**1.2 RELATED REQUIREMENTS**

- A. Section 09 0500 – Common Work Results for Finishes

**1.3 REFERENCE STANDARDS**

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- C. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute.
- D. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association.

**1.4 SUBMITTALS**

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- C. Manufacturer's Installation Instructions: Indicate special procedures.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet with minimum five years' experience.

**1.6 FIELD CONDITIONS**

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Refer to the Finish Schedule.

**2.2 ACCESSORIES**

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, standard color selected by the Architect.
- C. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

### **3.2 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Vacuum clean substrate.

### **3.3 INSTALLATION**

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet Pin accordance with manufacturer's instructions and CRI Carpet Installation Standard.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Layout: See drawings.
- G. Adhere carpet tile to substrate along centerline of rooms, at perimeter of rooms, where tiles are cut, and at 15-foot (4.5 m) intervals throughout rooms. Lay remainder of tile dry over substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.

### **3.4 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

**END OF SECTION 09 6813**

**SECTION 09 8100  
ACOUSTICAL INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Sound attenuation insulation for concealed applications.

**1.3 RELATED REQUIREMENTS**

- A. Section 07 2100 – Thermal Insulation
- B. Section 09 2116 – Gypsum Board Assemblies

**1.4 SUBMITTALS**

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

**PART 2 - PRODUCTS**

**2.1 ACCEPTABLE MANUFACTURERS**

- A. CertainTeed Corporation.
- B. Johns Manville.
- C. Owens Corning.

**2.2 ACOUSTICAL INSULATION**

Type: Unfaced glass fiber acoustical insulation complying with ASTM C 665, Type I.

- A. Thickness: As required for self-supporting friction-fit in stud cavities
- B. Density 2.5 pcf
- C. Surface Burning Characteristics:
  - 1. Maximum flame spread: 0
  - 2. Maximum smoke developed: 0When tested in accordance with ASTM E 84.
- C. Combustion Characteristics: Passes ASTM E 136.
- E. Fire Resistance Ratings: Passes ASTM E 119 as part of a complete fire tested wall assembly.
- F. Sound Transmission Class: STC 50
- G. Dimensional Stability: Linear Shrinkage less than 0.1%

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

**3.2 PROTECTION**

- A. Protect installed insulation prior to its concealment.

**END OF SECTION 09 8100**

**SECTION 09 9000  
PAINTING AND COATING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Surfaces to be finished are indicated in this section and on the Drawings.

**1.2 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, [www.paintinfo.com](http://www.paintinfo.com).
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Master Painters and Decorators Association; current edition.

**1.3 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
  - 2. MPI product number (e.g. MPI #47).
  - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system (copy of relevant MPI Manual page is acceptable).
- C. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- D. Samples: Submit three paper "drop" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
  - 1. Where sheen is specified, submit samples in only that sheen.
  - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
  - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
  - 4. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, siding, factory finished metals, wood cabinets, wood doors, and shingle roofing, have been approved.

**1.4 QUALITY ASSURANCE**

- A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years' experience.
- B. Maintain one copy of relevant portions of MPI Architectural Painting Specification Manual on project site at all times.
- C. Material Safety Data Sheets: At project site maintain file of MSDS sheets for each product used; become familiar with and follow manufacturer's stated application and safety requirements.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

## 1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

## 1.7 EXTRA MATERIALS

- A. See Section 01 6000 - Product Requirements, for additional provisions.
- B. Supply 1 gallon of each color; store where directed.
- C. Label each container with color in addition to the manufacturer's label.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible.
- C. In the event that a single manufacturer cannot provide all specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- D. See paint schedule in this section for allowable manufacturers. In the event a product is not listed in that table, notify the architect and they will select the appropriate paint.
- E. Substitutions: Not permitted.

### 2.2 MATERIALS - GENERAL

- A. Volatile Organic Compound (VOC) Content:
  - 1. Provide coatings that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:
      - 1) Opaque, Flat: 50 g/L, maximum.
      - 2) Opaque, Nonflat: 150 g/L, maximum.
      - 3) Opaque, High Gloss: 250 g/L, maximum.
      - 4) Varnishes: 350 g/L, maximum.
    - c. Architectural coatings VOC limits of state in which the project is located.
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- B. Paints and Coatings: Where MPI product numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI Categories, except as otherwise indicated.
  - 1. Provide ready mixed paints and coatings.
  - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

- C. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified; commercial quality.
- D. Patching Material: Latex filler.

### **2.3 PAINT SYSTEMS**

- A. Provide Premium Grade systems (2 top coats) as defined in MPI Architectural Painting Specification Manual, except as otherwise indicated.
- B. Where a specified paint system does not have a Premium Grade, provide Custom Grade system.
- C. Where sheen is not specified or more than one sheen is specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Provide colors as directed by Architect.
  - 1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner. One coat primer two coats finish and additional as required to coat or meet other minimums.
  - 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

## **PART 3 - EXECUTION**

### **3.1 SCOPE -- SURFACES TO BE FINISHED**

- A. Paint all exposed surfaces except where indicated not to be painted or to remain natural; the term "exposed" includes areas visible, inside and outside, through permanent and built-in fixtures when they are in place.
  - 1. To the extent a surface is not identified in this section, notify the architect and a material will be selected. All surfaces are to be included in the contractor's price.
- B. Paint the surfaces described in this section and/or indicated on the Drawings, and as follows:
  - 1. If a surface, material, or item is not specifically mentioned, paint in the same manner as similar surfaces, materials, or items, regardless of whether colors are indicated or not.
  - 2. Paint surfaces behind movable equipment and furnishings the same as similar exposed surfaces.
  - 3. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of the permanent item.
  - 4. Paint back sides of access panels and removable and hinged covers to match exposed surfaces.
  - 5. Finish top, bottom, and side edges of exterior doors the same as exposed faces.
  - 6. Paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment occurring in finished areas to match background surfaces, unless otherwise indicated.
  - 7. Paint shop-primed mechanical and electrical items occurring in finished areas.
  - 8. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  - 9. Paint interior surfaces of air ducts and convector and baseboard heating cabinets with flat, nonspecular black paint where visible through registers, grilles, or louvers.
  - 10. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.
  - 11. Paint all exterior cement composite board and siding.
  - 12. Paint all unfinished exterior metals.
  - 13. Paint all concrete and pavement items indicated in the drawings.
  - 14. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
- C. Do Not Paint or Finish the Following Items:
  - 1. Items fully factory-finished unless specifically noted; factory-primed items are not considered factory-finished.
  - 2. Items indicated to receive other finish.
  - 3. Items indicated to remain naturally finished.

4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Anodized aluminum.
6. Polished and brushed stainless steel items.
7. Brick, precast concrete, integrally colored plaster.

### 3.2 EXAMINATION

- A. Verify that surfaces are ready to receive Work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials; report incompatible primer conditions and submit recommended changes for Architect's approval.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
  1. Plaster and Gypsum Board: 12 percent.
  2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  3. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
  4. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.
  5. Concrete Floors: 8 percent.
- E. Measure the pH factor of concrete, masonry, and mortar before starting any finishing process, using the method specified in MPI Architectural Painting Manual.
  1. Report results in writing to Architect before starting work.
  2. If results of test indicates need for remedial action, provide written description of remedial action. If a different primer or paint systems is required, state the total cost of the change. Do not proceed with remedial action or change without receiving written authorization from Architect.

### 3.3 PREPARATION

- A. Prepare surfaces as specified in MPI Architectural Painting Specification Manual and as follows for the applicable surface and coating; if multiple preparation treatments are specified, use as many as necessary for best results; where the Manual references external standards for preparation (e.g. SSPC standards), prepare as specified in those standards; comply with coating manufacturer's specific preparation methods or treatments, if any.
- B. Coordinate painting work with cleaning and preparation work so that dust and other contaminants do not fall on newly painted, wet surfaces.
- C. Surface Appurtenances: Prior to preparing surfaces or finishing, remove electrical plates, hardware, light fixtures, light fixture trim, escutcheons, machined surfaces, fittings, and similar items already installed that are not to be painted.
  1. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before preparation and finishing.
  2. After completing painting in each space or area, reinstall items removed using workers skilled in the trades involved.
- D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- E. Marks: Seal with shellac those which may bleed through surface finishes.
- F. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete, Cement Plaster and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
  1. Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease,

- oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
2. Determine alkalinity and moisture content of surfaces by performing appropriate tests as specified in MPI Manual. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture is present.
- H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Asphalt, Creosote, or Bituminous Surfaces to be Painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.
- J. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.
- K. Concrete Floors to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- L. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
1. Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical or chemical methods as recommended as best practice by primer manufacturer.
- M. Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
1. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- N. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- O. Interior Wood Items to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- P. Interior Wood Items to Receive Transparent Finish: Sand wood to obtain a uniform appearance before immediately starting work. Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- Q. Exterior Wood to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- R. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- S. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- T. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 3.4 APPLICATION

- A. Apply products in accordance with manufacturer's instructions and as specified or recommended by MPI Manual, using the preparation, products, sheens, textures, and colors as indicated.
1. Remove, refinish, or repaint work not complying with requirements.



- B. Do not apply finishes over dirt, rust, scale, grease, moisture, scuffed surfaces, or other conditions detrimental to formation of a durable coating film; do not apply finishes to surfaces that are not dry.
- C. Use applicators and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
  - 1. Brush Application: Use brushes best suited for the type of material applied; use brush of appropriate size for the surface or item being painted; produce results free of visible brush marks.
  - 2. Roller Application: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
  - 3. Spray Application: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
  - 4. Where application method is listed in the MPI Manual for the paint system that application method is required; otherwise, any application method recommended by manufacturer for material used and objects to be painted is acceptable.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate; provide total dry film thickness of entire system as recommended by manufacturer.
  - 1. Number of coats and film thickness required are the same regardless of application method.
  - 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance.
  - 3. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.
- E. Apply finish to completely cover surfaces with uniform appearance without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
  - 1. Before applying finish coats, apply a prime coat of material recommended by manufacturer, unless the surface has been prime coated by others; where evidence of suction spots or unsealed areas in first coat appear, recoat primed and sealed surfaces to ensure finish coat with no burn through or other defects due to insufficient sealing.
  - 2. Apply first coat to surface that has been cleaned, pretreated, or otherwise prepared as soon as practical after preparation and before subsequent surface deterioration.
  - 3. Do not apply succeeding coats until the previous coat has cured as recommended by manufacturer.
  - 4. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat will not cause the undercoat to lift or lose adhesion.
  - 5. If manufacturer's instructions recommend sanding to produce a smooth, even surface, sand between coats.
  - 6. Before applying next coat vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

### **3.5 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

### **3.6 CLEANING AND PROTECTION**

- A. Collect waste material which may constitute a fire hazard, place in closed metal containers, and remove daily from site.
- B. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from site.
- C. Protect other work, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting as approved by Architect.
- D. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in MPI Manual.

**3.7 SCHEDULE**

- A. See attached spreadsheet for paint schedule. Refer to the drawings for locations and color scheme.
- B. Items that are not specially listed in the table above shall be painted per industry standards, whether listed or not at no additional cost to the owner.
- C. If not indicated, the architect will select all colors and sheens.

**END OF SECTION 09 9000**

**Exterior Paint Schedule**

Item	Requirement Substrate	Location	Mils per coat (Wet/Dry)		Plattsburg		Sherwin Williams		Benjamin Moore		Pratt & Lambert		Finish		Notes
			Primer	Finish	Primer	2 Finish	Primer	2 Finish	Primer	2 Finish	Primer	2 Finish	Luster	Final Coats	
Ferrous Metals	Primer on Bare Metal	Stacks, Pipes, Beams, Misc Metals	6	3	94-238 Multi Prime	7-844 Alkyd Semi Gloss Enamel	KemKromik Metal Primer B50Z	MetaIasticDTM B55Z Series	M06 Alkyd Metal Primer	M29 DTM Acrylic	S4501 Rust Inhibitive Metal Primer	Maint. Gloss S4500 Series	Semi gloss	Acrylic Enamel	
Factory Primed Steel	Factory Primed	Doors and Frames, Exposed Piping	-	3.25	90-709 Pitt-Tech Primer Finish DTM	90-474 Pitt-Tech High Performance Waterborne DTM Enamel	DTM Acrylic Primer/Finish	DTM Acrylic Semi-Gloss #B66-200	M29 DTM	M29 DTM	Enducry DTM Z6600 Series	Enducry DTM Z6600 Series	Semi gloss	Acrylic Enamel	
Galvanized Steel	Factory Galvanized	Lintels, frames, supports, steel beams, columns, etc	10	3.5	90-709 Pitt-Tech Primer Finish DTM	90-474 Pitt-Tech High Perf. Waterborne DTM Ind. Enamel	Sher-Cryl High Perf. Acrylic Pro-Cryl Univ. Primer	DTM Acrylic Semi-Gloss #B66-200	M29 DTM Acrylic	M29 DTM Acrylic Semi-Gloss	Steeltech Z6631 (Off White) Universal Primer	Enducry Acrylic Semi-Gloss	Semi gloss	Acrylic Enamel	
Galvanized Steel	Factory Galvanized	HM Doors & frames any exposed metals, bollards, gates/post	10	3.5	90-709 Pitt-Tech Primer Finish DTM	90-474 Pitt-Tech High Perf. Waterborne DTM Ind. Enamel	Pro-Cryl Universal Primer	Sher-Cryl High Performance Acrylic Semi-Gloss	M29 DTM Acrylic	M29 DTM Acrylic Semi-Gloss	Steeltech Z6631 (Off White) Universal Primer	Enducry Acrylic Semi-Gloss	Semi gloss	Acrylic Enamel	Primed by not finished painted exterior and site items
Cement/Fiber Siding and Trim	Factory Primed	Exterior Cement Siding	8	3.2	Per the Manf.	SpeedHide Acrylic Latex 6-900	S-W Loxon Acrylic Masonry Primer, A24W8300	S-W Metalatex Acrylic Semi-Gloss, B42 Series	Per the Manf.	Per the Manf.	Per the Manf.	Per the Manf.	Semi - Gloss	Latex	
Ext. Wood	Wood	Sheds, benches, fences, ext wood	-	4	Ext. Stain; applied on species indicated to match Architect's sample.	Ext. Stain; applied on species indicated to match Architect's sample.	Woodpride Exterior Gloss Polyurethane Varnish	Exterior Wood Classics Polyurethane Varnish A67 Series	Ext. Stain; applied on species indicated to match Architect's sample.	Ext. Stain; applied on species indicated to match Architect's sample.	Ext. Stain; applied on species indicated to match Architect's sample.	exterior varnish	Low	Poly-urethane	Unfinished wood
Traffic Paint	Concrete or Asphalt	parking lots			Per the Manf.	SpeedHide traffic zone line 11-53	Water Reducible Acrylic -4800	Per the Manf.	Per the Manf.	Per the Manf.	Per the Manf.	Per the Manf.			
Exterior CMU	Concrete Block	Misc Walls	16	8	4	2	Block-Fill 4000 Int/Ext Acrylic Block Filler	LTC Block Surface Filler-4-100	S-W PrepRite Block Filler, B25W25	S-W Metalatex Acrylic Semi-Gloss, B42 Series	Pro-Hide Silver Z8485 Block Filler	Super Spec Ext. Acrylic 184	Pro-Hide Silver Int. Ext. Semi Gloss z8301	Semi gloss	Acrylic Latex



Gypsum Board - Standard Wall Application	Gypsum Board	General Areas	4	1.25	4	1.5	Dulux Gripper 3210	Dulux Pro Premium 1402 Acrylic Latex Eggshell	6-2 SpeedHide Interior Quick-Drying Latex Sealer	6-411 Series SpeedHide Eggshell/Acrylic Latex Enamel	PrepRite 200 Latex Primer B28W200 Series	ProMar 200 Latex Egg-shell B20 Series	253 Superspec Primer	274 Superspec Eggshell	Z8160 Pro-Hide Gold Latex Primer	Pro-Hide Gold Series Latex Eggshell	Egg-shell	Latex	
Gypsum Board - Soffits	Gypsum Board	Soffits and Ceilings	4	1.25	4	1.5	Dulux Gripper 3210	Dulux 1210	6-2 SpeedHide Interior Quick-Drying Latex Sealer	6-70 Line SpeedHide Interior Wall Flat Latex Paint	PrepRite 200 Latex Primer B28W200 Series	ProMar 200 Flat Latex B30-200 Series	253 Superspec Primer	275 Superspec Flat	Z8160 Pro-Hide Gold Latex Primer	Z8100 Series Pro-Hide Gold Flat Latex	Flat	Latex	
Gypsum Board - Subbubble	Gypsum Board	Walls	4	1.25	4	1.5	Prep & Prime Gripper 3210 Primer Sealer	Tri-Glaze-WB 4406 Waterborne Epoxy Semi-Gloss Coating	6-2 SpeedHide Interior Quick-Drying Latex Sealer	16-551 Pitt-Glaze WB Acrylic Epoxy Semi-Gloss	PrepRite 200 Latex Primer B28W200 Series	Water Based Catalyzed Epoxy Semi-Gloss B70 Series	023 Fresh Start Primer	M43/M44 Acrylic Epoxy Semi-Gloss	Z8160 Pro-Hide Gold Latex Primer	Enducryl Water Based Catalyzed Epoxy Series (Z7025 Semi-Gloss Activator)	Semi-Gloss	Epoxy	Scrubable and wet Applications
Gypsum Board - Subbubble	Gypsum Board	Kitchens and Baths	4	1.25	4	1.5	Prep & Prime Gripper 3210 Primer Sealer	Zinsser Bathroom and Kitchen paint	-	-	-	-	-	-	-	-	Gloss	Latex	Scrubable and wet Applications
VCT Flooring	VCT	Gym Floors	-	5	-	6	Devfloor 506 Water-Based Epoxy Primer and Devfloor 525 100% Solids Epoxy Surfacer	Devfloor 568 High Solids Urethane	PPG MegaSeal 99-6639 High Solids Primer Clear and 1 coat MegaSeal WB Primer Gray	PPG Megaseal HPU 99-6730 High Performance Urethane	CP #4531 primer at 500 to 1,000 sf per gallon and 1 coat GP #3504 High Solids Epoxy Primer	GP #4638 General Polymer	M36/M39 High Build Epoxy at 500 to 1,000 sf per gallon	coats of M36/M37 Epoxy Clear	S6700 Series HS Floor Epoxy and Activator	S6500 Series HS Polyurethane	Satin	Poly-Urethane	Stripping on VCT Floors

**SECTION 10 0500  
COMMON WORK RESULTS FOR SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. This Section includes basic requirements for specialties specified in subsequent Division 10 Sections.
- B. Related Work Specified in Other Sections: Section 06 1000 - Rough Carpentry.

**1.2 REFERENCES**

- A. General: Section 01 4200 - Reference Standards.
- B. Refer to individual Sections for extent of referenced standards specified in this Division.
- C. Americans With Disabilities Act (ADA).
- D. American Society for Testing and Materials (ASTM).
  - 1. ASTM A 153: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A 653: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 3. ASTM A 1008: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability.
  - 4. ASTM B 456: Standard Specification for Electrodeposited Coatings of Copper Plus Chromium and Nickel Plus Chromium.
  - 5. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 6. ASTM F 446: Consumer Safety Specification for Grab Bars and Accessories Installed in a Bathing Area.

**1.3 SUBMITTALS**

- A. General: Section 01 3300 – Submittal Procedures: For Submittal Procedures.
- B. Manufacturer's product data for specified products.
- C. Manufacturer's certifications certifying compliance with specified requirements and referenced standards.
- D. Shop drawings detailing installation of products, including supplementary framing, blocking, fastening requirements to comply with loading requirements, and conditions at rough openings and substrates.
- E. Templates and setting diagrams.
- F. Contract Closeout Submittals:
  - 1. General: Refer to Section 01 7000 – For Contract Closeout.
  - 2. Warranties: Executed warranties, signed by manufacturer and Contractor.
  - 3. Spare parts and keys: deliver to Owner's representative and retain signed receipts.
  - 4. Maintenance instructions for proper care and maintenance of products.

**1.4 QUALITY ASSURANCE**

- A. General: Section 01 4000 – Quality Requirements.
- B. Installer Qualifications: Engage only qualified installers to perform work.
- C. Source Limitation: Obtain each type of specified product from a single qualified manufacturer and distribution source.

**1.5 COORDINATION**

- A. Perform and record field measurements to ensure proper fit and function of products.
- B. Furnish installation instructions, templates, and setting diagrams to trades responsible for installation.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with manufacturer's delivery, storage, and handling information.

- B. Establish proper storage conditions at shops, the site, and other points of delivery to prevent loss, deterioration, damage, and theft.
  - 1. Provide temporary heat and humidity control if required to achieve the conditions required by referenced standards.
  - 2. Store products in accordance with referenced standards to prevent detrimental exposure, condensation, and other incidental damage at the site.
- C. Inspect and inventory products upon delivery. Reject defective or damaged products and promptly remove them from the Site.

**PART 2 - NOT USED**

**PART 3 - EXECUTION**

**3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution Requirements.

**3.2 INSPECTION**

- A. Verify acceptability of substrate conditions in accordance with referenced standards and manufacturer's instructions. Correct non-complying conditions, including removal of interfering elements, restoration of substrates, and installation of supplementary framing, blocking, and supports. Do not proceed with installation until all objectionable conditions are corrected.

**3.3 PREPARATION**

- A. Isolate components to prevent contact with incompatible substrates, including dissimilar metals to prevent galvanic reaction.

**3.4 INSTALLATION**

- A. Install products in accordance with the drawings, manufacturer's recommendations, and approved shop drawings.

**3.5 OPERATION AND ADJUSTMENT**

- A. Test installed products to ensure proper operation.

**END OF SECTION 10 0500**

**SECTION 10 1400  
SIGNAGE**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Signage required for occupancy requirements.
- B. Room and door signs.
- C. Signs shall include but not be limited to a project identity sign, informational signage, handicapped signs, building identifications signage, and apartment numbers. Toilet rooms, offices, storage, mechanical, laundry and other such rooms.

**1.2 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Verification Samples: Submit samples showing colors specified.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

**1.5 FIELD CONDITIONS**

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com).
  - 2. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com).
  - 3. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
  - 4. ASI Sign Systems Inc.
  - 5. Diskey Sign Corp.
  - 6. Ellet Sign Company.



## **2.2 SIGNAGE APPLICATIONS**

- A. Accessibility Compliance: All signs are required to comply with ADAAG and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
  - 1. Sign Type: Flat signs with engraved panel media as specified.
  - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
  - 3. Character Height: 1 inch.
  - 4. Sign Height: 2 inches, unless otherwise indicated.
  - 5. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section for replaceable occupant name.
  - 6. Service Rooms: Identify with room names and numbers to be determined later, not those shown on the drawings.
  - 7. Public Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Informational Signs:
  - 1. Sign Type: Same as room and door signs.
  - 2. Sizes: As indicated on the drawings.

## **2.3 SIGN TYPES**

- A. Flat Signs: Signage media without frame.
  - 1. Edges: Square.
  - 2. Corners: Square.
  - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
  - 1. Character Font: Helvetica, Arial, or other sans serif font.
  - 2. Character Case: Upper case only.
  - 3. Background Color: Clear.
  - 4. Character Color: Contrasting color as selected by Architect from manufacturer's full standard range.

## **2.4 TACTILE SIGNAGE MEDIA**

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  - 1. Total Thickness: 1/16 inch.

## **2.5 NON-TACTILE SIGNAGE MEDIA**

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
  - 1. Sign Color: Clear.
  - 2. Total Thickness: 1/8 inch.

## **2.6 ACCESSORIES**

- A. Tape Adhesive: Double sided tape, permanent adhesive.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

### **3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.

- C. Signage on glass to have solid back panel.
- D. Locate signs where indicated:
  - 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
  - 2. If no location is indicated obtain Owner's instructions.
- E. Protect from damage until Substantial Completion; repair or replace damage items.

**END OF SECTION 10 1400**

**SECTION 10 2601  
DOOR, WALL AND CORNER GUARDS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Door Protection.
- B. Corner guards.
- C. Corridor handrails.

**1.2 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Samples: Submit two sections of bumper rail, 24 inch long, illustrating component design, configuration, color and finish.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Door, Wall and Corner Guards:
  - 1. Arden Architectural Specialties, Inc: [www.ardenarch.com](http://www.ardenarch.com).
  - 2. Construction Specialties, Inc: [www.c-sgroup.com](http://www.c-sgroup.com).
  - 3. InPro Corporation: [www.inprocorp.com](http://www.inprocorp.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

**2.2 COMPONENTS**

- A. Door: Shop-fabricated, with preformed edge caps and internal:
  - 1. Performance of Installed Assembly:
    - a. Resist lateral force of 250 lbs at any point without damage or permanent set.
  - 2. Material: Polyvinyl chloride, color as selected from manufacturer's standard colors.
  - 3. Mounting: Surface.
- B. Corridor Handrail: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
  - 1. Performance of Installed Assembly:
    - a. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
    - b. Resist lateral force of 250 lbs at any point without damage or permanent set.
  - 2. Material: Wood, oak species, finish as selected from manufacturer's standard finishes.
  - 3. Mounting: Surface.
- C. Corner Guard - Surface Mounted: High impact vinyl with extruded aluminum full height retainer and integral impact absorbing device.
  - 1. Size: 2 inches.
  - 2. Corner: Square.
  - 3. Color: Architect to selected from manufacturer's standard colors.
  - 4. Length: One piece.
  - 5. Preformed end caps.

**2.3 FABRICATION**

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

**PART 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on Drawings.

**3.2 INSTALLATION**

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Terminate rails 6 inches short of door opening.

**3.3 TOLERANCES**

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

**END OF SECTION 10 2601**

**SECTION 10 2601  
CORNER GUARDS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Corner Guards to be installed throughout all MU Units

**1.2 ACTION SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

**PART - 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Door, Wall and Corner Guards:
  - 1. Arden Architectural Specialties, Inc: [www.ardenarch.com](http://www.ardenarch.com).
  - 2. Construction Specialties, Inc: [www.c-sgroup.com](http://www.c-sgroup.com).
  - 3. InPro Corporation: [www.inprocorp.com](http://www.inprocorp.com).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

**2.2 COMPONENTS**

- A. Corner Guard - Surface Mounted: High impact vinyl with extruded aluminum full height retainer and integral impact absorbing device.
  - 1. Size: 2 inches.
  - 2. Corner: Square.
  - 3. Color: Architect to selected from manufacturer's standard colors.
  - 4. Length: One piece.
  - 5. Preformed end caps.

**2.3 FABRICATION**

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.
- C. Form end trim closure by capping and finishing smooth.

**PART - 3 EXECUTION**

**3.1 EXAMINATION**

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located
- B. Verify that field measurements are as indicated on Drawings.

**3.2 INSTALLATION**

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Terminate rails 6 inches short of door opening.

**3.3 TOLERANCES**

- A. Maximum Variation from Required Height: 1/4 inch.
- B. Maximum Variation from Level or Plane for Visible Length: 1/4 inch.

**END OF SECTION 10 2601**

**SECTION 10 2800  
TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Accessories for showers, residential bathrooms, and public restrooms.
- B. Grab bars.
- C. Mirrors

**1.2 REFERENCE STANDARDS**

- A. ASTM B 456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; current edition.
- B. ASTM C 1036 - Standard Specification for Flat Glass; current edition.
- C. GSA CID A-A-3002 - Mirrors, Glass; U.S. General Services Administration; current edition.

**1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

**1.4 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Toilet Accessories: - Public Restrooms
  - 1. A & J Washroom Accessories Inc: [www.ajwashroom.com](http://www.ajwashroom.com).
  - 2. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com).
  - 3. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com).
  - 4. Substitutions: Section 01 6000 - Product Requirements.

**2.2 MATERIALS**

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Mirror Glass: Float glass, ASTM C 1036 Type I, Class 1, Quality Q2, with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with GSA CID A-A-3002.
- C. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.
- D. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

**2.3 FINISHES**

- A. Chrome/Nickel Plating: ASTM B 456, SC 2, satin finish, unless otherwise noted.
- B. Back paint components where contact is made with building finishes to prevent electrolysis.

**2.4 PUBLIC TOILET ROOMS**

- A. Toilet Paper Dispenser: Single roll, surface-mounted, stainless steel unit with pivot hinge.
  - 1. Basis of Design: Bobrick B-264
- B. Paper Towel Dispenser: Trifold, surface mounted, stainless steel unit with lock.
  - 1. Basis of Design: Harney Hardware #19034
- C. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator, tumbler lock.
  - 1. Minimum Capacity: 48 ounces.

2. Basis of Design: Harney Hardware #19059
- D. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
  1. Size: as shown on drawings.
  2. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; No.4 finish.
  3. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
  4. Fixed Tilt Mirrors: Minimum 3 inches tilt from top to bottom.
- E. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
  1. Length: 18, 36 and 42 inches
  2. Basis of Design: Harney Hardware #71769, 71772 and 71773

## 2.5 RESIDENTIAL TOILET ROOM ACCESSORIES

- A. Toilet Paper Dispenser: Single roll, surface mounted bracket type, chrome-plated steel brackets.
  1. Basis of Design: Clearwater Surface Holder #10202 manufactured by Harney Hardware.
- B. Mirrors: Stainless steel framed, 6 mm thick float glass mirror.
  1. Basis of Design: Bradley #781
- C. Grab Bars in MU Units: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.
  1. Length: 18, 36 and 42 inches
  2. Basis of Design: Harney Hardware #71769, 71772 and 71773
- D. Medicine Cabinets in non-MU Units: Basis of Design: HD Supply American Pride, 16" wide x 26" high recessed raised panel medicine cabinet #115194.
- E. Medicine Cabinets in MU Units: Basis of Design: HD Supply American Pride, 16" wide x 26" high recessed raised panel medicine cabinet #115194.

## 2.6 SHOWER AND TUB ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Towel Bar: Stainless steel Type 304, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
  1. Length: 24 inches.
  2. Basis of Design: Clearwater #10204 manufactured by Harney Hardware.
- C. Robe Hook: Heavy-duty stainless steel, double-prong, Round bracket and backplate for concealed attachment, satin finish.
  1. Basis of Design: Clearwater #10200 manufactured by Harney Hardware.
- D. Towel Ring: Stainless steel Type 304, concealed attachment, satin finish.
  1. Basis of Design: Clearwater #10205 manufactured by Harney Hardware.

## 2.7 MOP HOLDER / SHELF UNITS

- A. 8-inches deep X 34" long with 3 holders and 4 hooks.
  1. Basis of Design: Bobrick B-239-344.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.
- D. See Section 06 1000 for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

### **3.2 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.
- C. Provide blocking for all accessories.

### **3.3 INSTALLATION**

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

**END OF SECTION 10 2800**



**SECTION 10 4400  
FIRE PROTECTION SPECIALTIES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Emergency key cabinets.

**1.2 SUBMITTALS**

- A. Shop Drawings: Indicate cabinet physical dimensions.
- B. Product Data: Provide extinguisher operational features.

**PART 2 - PRODUCTS**

**2.1 FIRE EXTINGUISHERS**

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Stainless steel tank, with pressure gage.
  - 1. Class: B:C.
  - 2. Size: 10 pound.
  - 3. Finish: Baked enamel, color as selected.
- C. Coordinate with the local jurisdiction for quantities, locations and mounting heights

**2.2 FIRE EXTINGUISHER CABINETS**

- A. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
- B. Cabinet Configuration: Recessed type.
  - 1. Sized to accommodate accessories.
  - 2. Trimless type.
- C. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
- D. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- E. Finish of Cabinet Exterior Trim and Door: Polished chrome.
- F. Finish of Cabinet Interior: White enamel.

**2.3 EMERGENCY KEY CABINETS**

- A. Furnish and install emergency key cabinet of type and in location approved by the local Fire Marshall and complying with UL 1037. Basis of Design Manufacturer is Knox Company.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

**3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers and accessories in cabinets.

**END OF SECTION 10 4400**

**SECTION 10 5523  
MAIL BOXES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Multiple front-loading mail boxes with hinged and locked doors and parcel containers.

**1.2 REFERENCE STANDARDS**

- A. 39 CFR 111 - U.S. Postal Service Standard 4C; effective date September 3, 2006.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Mail Boxes:
  - 1. Auth-Florence Manufacturing Company.
  - 2. Bommer Industries, Inc.
  - 3. Salsbury Industries.

**2.2 MAIL BOXES SERVED BY U.S. POSTAL SERVICE**

- A. Comply with U.S. Postal Service Standard 4C.
- B. Box Sizes: Refer to the Drawings.

**2.3 COMPONENTS**

- A. Front Loading Panel Frame:
  - 1. Aluminum with mill finish.
  - 2. Edges beveled, piano hinged jamb, prepared for Post Office lock cylinder.
- B. Box Door:
  - 1. Aluminum with mill finish.
  - 2. Edges beveled, piano hinged jamb, prepared for lock cylinder.
- C. Box Construction: Sheet steel, zinc coated, 22 gage (0.8 mm) thick, fabricated into modular stackable units, baked enamel flat black finish. Pre-punch bolt holes in box for stack bolting to each other and anchoring to adjacent construction; label plates for identifying each box.
- D. Postal Box Locks: Five pin tumbler lock cylinder, two keys per box, cylinders master keyed to group with two master keys.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that prepared openings are ready to receive work.

**3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and U.S. Postal Service regulations.
- B. Install and secure boxes in position, neatly, and accurately stacked.
- C. Install doors and adjust to operate smoothly.

**END OF SECTION 10 5523**

**SECTION 10 5623  
WIRE STORAGE SHELVING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Wall mounted wire closet shelving.
- B. Accessories.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis of Design: ClosetMaid Corporation Superslide: [www.closetmaid.com](http://www.closetmaid.com).

**2.2 SHELVING APPLICATIONS**

- A. Shelf Depth: 12 inches (305 mm), unless otherwise indicated.

**2.3 MATERIALS**

- A. Wire Shelving: Factory-assembled coated wire mesh shelf assemblies for wall-mounting, with all components and connections required to produce a rigid structure that is free of buckling and warping.
  - 1. Construction: Cold-drawn steel wire with average tensile strength of 100,000 psi (690 MPa) resistance welded into uniform mesh units, square, rigid, flat, and free of dents or other distortions, with wires trimmed smooth.
  - 2. Coating: PVC or epoxy, applied after fabrication, covering all surfaces.
  - 3. PVC Coating: 9 to 11 mils (0.23 to 0.028 mm) thick.
  - 4. Standard Mesh Shelves: Cross deck wires spaced at 1 inch (25.4 mm).
  - 5. Shelf and Rod Units: Integral hanging rod at front edge of shelf.
- B. Mounting Hardware: Provide manufacturer's standard mounting hardware; include support braces, wall brackets, back clips, end clips, poles, and other accessories as required for complete and secure installation; factory finished to match shelving.
- C. Fasteners: As recommended by manufacturer for mounting substrates.
- D. Adjustable height standards and brackets in Accessible Units, Pantry's and Common Areas.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, with shelf surfaces level.
- B. Cap exposed ends of cut wires.
- C. Install back clips, end clips at side walls, and support braces at open ends. Install intermediate support braces as recommended by manufacturer.
- D. Mounting Heights:
  - 1. Single Hanging Rod Units: Install shelf at 68 inches (1727 mm) above floor.
  - 2. Double Hanging Rod Units: Install shelves at 42 inches (1067 mm) and 84 inches (2134 mm) above floor.

**END OF SECTION 10 5623**

**SECTION 11 3100  
RESIDENTIAL APPLIANCES**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Energy Star rated kitchen appliances.
- B. Installation of Owner-Furnished laundry equipment.

**1.2 RELATED REQUIREMENTS**

- A. Division 26 Section

**1.3 REFERENCE STANDARDS**

- A. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

**1.4 SUBMITTALS**

- A. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified.
- B. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL and complying with NEMA standards.

**1.6 WARRANTY**

- A. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.

**PART 2 - PRODUCTS**

**2.1 KITCHEN APPLIANCES**

- A. General: All equipment shall be Energy Star qualified.
- B. Refrigerator/Freezer, Top Freezer Type
  - 1. Basis of Design for Apartments: GE Energy Star 16.6 Cu. Ft. Model No. GTE17DTNRBB
  - 2. Basis of Design Community Room: GE Energy Star 17.5 Cu. Ft. Model No. G1E18DTNRBB
- C. Electric Range, Accessible Units
  - 1. Basis of Design: GE 30" Drop-In Electric Range, Model #JD630DFBB
  - 2. Provide GE Filler Panel Model No. WB07T10680
- D. Electric Range, All other Units
  - 1. Basis of Design: GE 30" Freestanding Electric Range, Model #JBS460DMBB
- E. Range Hood Accessible: GE Standard Range Hood, Model #JV338HBB
- F. Laundry Equipment: Energy Star; Provided by Owner and installed by Contractor.
  - 1. Provide drain pan or stainless-steel braided hoses at all washers.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify utility rough-ins are present and correctly located.

**3.2 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

**3.3 ADJUSTING**

- A. Adjust operating equipment to efficient operation.

**3.4 CLEANING**

- A. Remove packing materials from equipment.
- B. Wash and clean equipment.

**END OF SECTION 11 3100**

**SECTION 11 8227  
WASTE COMPACTORS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Packaged waste compactor with integral container.
- B. Packaged waste compactor for separate container.

**1.2 RELATED REQUIREMENTS**

- A. Section 14 9100 - Facility Chutes: Chute intake door locking mechanism and interlocking requirements.

**1.3 REFERENCE STANDARDS**

- A. ANSI Z245.2 - American National Standard for Stationary Compactors -- Safety Requirements for Installation, Maintenance, and Operation; 2008.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
- C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2011.

**1.4 SUBMITTALS**

- A. Product Data: Provide unit capacities, physical dimensions, utility requirements and locations, point loads.
- B. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.
- C. Contract Closeout Submittals:
  - 1. Operation Data: Include description of system operation, adjusting and testing required.
  - 2. Maintenance Data: Identify system maintenance requirements, servicing cycles, lubrication types required and local spare part sources.
  - 3. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.5 WARRANTY**

- A. Correct defective Work within a five year period after Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis of Design: As indicated under product article below.
- B. Waste Compactors:
  - 1. Marathon Equipment Co; Product Mini-MAC 3A Compactor; [www.marathonequipment.com](http://www.marathonequipment.com).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

**2.2 APPLICATIONS**

- A. Compactor in Trash Chute Room: Apartment type, chute and left side intakes.
  - 1. Service Conditions: Interior.

**2.3 COMPACTORS - GENERAL**

- A. Motors: NEMA MG 1.
- B. Control Panels and Remote Equipment Enclosures: NEMA 250 Type 4 enclosures; factory finished; wall-mounted unless otherwise indicated.
- C. Discharge Containers: Heavy duty steel; factory-finished for outdoor use; manufacturer's standard type unless otherwise indicated.
- D. Anchors and Fasteners: Galvanized steel; where embedded in concrete, provide to concrete installer for installation.

## **2.4 APARTMENT COMPACTORS**

- A. Apartment Compactors: Small footprint; heavy duty steel body consisting of a charge box over a compactor unit that compresses horizontally into separate container; hydraulically driven compaction ram.
  - 1. Configuration: As indicated on the drawings.
  - 2. Power Unit: Hydraulic pump and oil reservoir; located inside compactor room; provide hydraulic piping and electrical connections.
  - 3. Electrical Characteristics: 208/230/480 V, 3 phase, 60 Hz.
  - 4. Controls and Safeties:
    - a. "On/Off" key switch.
    - b. Automatic photoelectric sensor start and stop.
    - c. Emergency stop button.
    - d. "Container-Full" indicator light.
    - e. Magnetic door and container interlock.
    - f. Container removal safety signal.
    - g. Built-in container stops.
- B. Chute Extension: Provide extension of chute to fit compactor, as indicated on the drawings.
- C. Discharge Container: Roll-off type.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify that anchors are correctly positioned.

### **3.2 INSTALLATION**

- A. Install unit and inlet hopper in accordance with manufacturer's instructions and with standards required by authority having jurisdiction.
- B. Coordinate with waste chute discharge.
- C. Anchor unit securely in place.
- D. Touch-up minor damaged surfaces caused during installation. Replace damaged components as directed by Architect.
- E. Adjust unit mechanism to achieve specified requirements.

### **3.3 CLOSEOUT ACTIVITIES**

- A. Demonstrate and instruct Owner on unit operation. Describe unit limitations.

**END OF SECTION 11 8227**

## **SECTION 12 2100 WINDOW BLINDS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SECTION INCLUDES**

- A. Horizontal mini-blinds with vinyl louver slats.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of horizontal louver blinds. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.
- C. Samples for Initial Selection: Manufacturer's full range of available selections. Provide for each colored component of each type of horizontal louver blind indicated.
- D. Samples for Verification: For the following products, prepared on Samples from the same material to be used for the Work.

#### **1.4 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Flame-Resistance Ratings: Passes NFPA 701.
- B. Corded Window Covering Product Standard: Provide horizontal louver blinds complying with WCMA A 100.1.

#### **1.5 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where horizontal louver blinds 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 operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Hunter Douglas or Levelor Blinds are the basis of the design for horizontal mini-blinds.
  - 1. Louvers shall be 1" width.
  - 2. Provide Aluminum valance. Color to match blinds. Louver directional control to be by cord. Traversing to be by wand. Install blinds in strict accordance with manufacturer's instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXECUTION, GENERAL**

- A. Refer to Section 01 7000 – Execution and Closeout Requirements.



### **3.2 HORIZONTAL LOUVER BLIND INSTALLATION**

- A. Jamb Mounted: Install headrail flush with face of opening jamb and head.

### **3.3 ADJUSTING**

- A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### **3.4 CLEANING AND PROTECTION**

- A. Clean blind 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 horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

**END OF SECTION 12 2100**

**SECTION 12 3530  
RESIDENTIAL CASEWORK**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Kitchen cabinets and bathroom vanities.
- B. Casework hardware

**1.3 RELATED REQUIREMENTS**

- A. Section 12 3661 – Quartz Countertops.

**1.4 REFERENCE STANDARDS**

- A. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; (ANSI/BHMA A156.9); current edition.
- B. ANSI/KCMA A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets; Kitchen Cabinet Manufacturers Association; current edition.
- C. ICPA: International Cast Plastics Alliance.
- D. KCMA (DIR) - Directory of Certified Cabinet Manufacturers; Kitchen Cabinet Manufacturers Association; current edition, online.

**1.5 SUBMITTALS**

- A. ANSI/KCMA A161.1 certification.
- B. Shop Drawings: Indicate casework locations, large scale plans, elevations, clearances required, rough-in and anchor placement dimensions and tolerances
- C. Samples for verification: Submit samples verifying material and colors.

**1.6 QUALITY ASSURANCE**

- A. Products: Complying with KCMA A161.1 and KCMA Certified.
- B. Manufacturer: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.7 MOCK-UP:**

- A. Full size mock-up of casework base unit and hardware.
- B. Full size mock-up of casework and bathroom sink and countertop.

**PART 2 - PRODUCTS**

**2.1 KCMA CERTIFIED CABINETS**

- A. All cabinetry shall comply with ANSI/KCMA A161.1, and Paragraph 611-1.1, "HUD Minimum Property Standards - Housing 4910.1, and be certified and labeled as such.
- B. Acceptable Manufacturer: Smart Cabinetry. Color to be selected by Architect.

**2.2 COMPONENTS**

- A. Cabinet Construction: Softwood lumber framing and plywood board.  
Partial board components are not acceptable
- B. Countertops (not in bathrooms) to be 2cm quartz from Quantra  
<https://quantra.in/product-category/slabs..>
  - 1. Colors selected by the Architect from manufactures full line.
- C. Cultured Marble Bathroom Sink and Surround: ICPA/NAHB certified to comply with ANSI Z124.3, Type 5 for cultured marble vanity tops with integral bowl, and molded backsplash.
  - 1. Cast polyester resin, calcium carbonate, catalyst, lightweight filler and selected pigments.

2. Gelcoat: Neophenyl Glycol (N.P.G.) Isophthalic, 20 mils thick at water impingement areas, 15 mils in other areas. U.V. stabilized.
3. Catalyst: Methyl Ethyl Ketone Peroxide with residual Hydrogen Peroxide content of less than 1%.
4. Polyester Resin: Minimum 65% solids, with specific gravity of 1.12 or higher.
5. Calcium Carbonate shall have specific gravity of 2.7 or greater and hardness (Mho's Scale) of 3 or greater.
6. Light weight Filler: Thermolite or compatible, with a minimum of 7% filler.
7. Color: Selected by Architect.

### **2.3 HARDWARE**

- A. Hardware: BHMA A156.9, Grade 1.
- B. Shelf Standards and Rests: Vertical steel standards with rubber button fitted steel rests.
- C. Shelf Brackets: Vertical chrome steel standards with chrome steel arms.
- D. Drawer Slides: Extension arms, steel and ball bearing construction. Captive roller (75 lbs) epoxy coated
- E. Hinges: Offset pin.
- F. Pulls: 4" Wire pull, brushed aluminum finish.

### **2.4 FABRICATION**

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
- C. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- D. Form smooth edges. Form material for countertops and shelves from continuous sheets.
- E. Fabricate each unit to be rigid and not dependent on building structure for rigidity.
- F. Provide cutouts for plumbing fixtures, appliances, and fixtures and fittings. Prime paint contact surfaces of cut edges.
- G. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Verify adequacy of support framing. Supplement as required to comply with the fabricator's recommendations.

### **3.2 INSTALLATION**

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Set casework items plumb and square, securely anchored to building structure.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch (1 mm). Use filler strips; not additional overlay trim for this purpose.
- D. Close ends of units, back splashes, shelves and bases.

### **3.3 ADJUSTING**

- A. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

### **3.4 CLEANING**

- A. Clean casework, countertops, shelves, and hardware.

### **3.5 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.

**END OF SECTION 12 3530**

**SECTION 12 3661  
QUARTZ AGGLOMERATE COUNTERTOPS**

**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. Quartz agglomerate countertops.
  - 2. Quartz agglomerate backsplashes.
  - 3. Quartz agglomerate end splashes.
- B. Related Requirements:
  - 1. Section 12 3530 Residential Casework
  - 2. Section 22 4400 "Plumbing Fixtures" for sinks and plumbing fittings.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For countertop materials.
- B. 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.
- C. Samples for Initial Selection: For each type of material exposed to view.
- D. Samples for Verification: For the following products:
  - 1. Countertop material, 6 inches square.
  - 2. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

**1.4 INFORMATIONAL SUBMITTALS:**

- A. Qualification Data: For fabricator; Min five years' experience.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For quartz agglomerate countertops 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.

**1.6 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  - 1. Build mockup of typical countertop as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

**1.7 FIELD CONDITIONS:** Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

**1.8 COORDINATION:** Coordinate locations of utilities that will penetrate countertops or backsplashes.

## **PART 2 - PRODUCTS**

### **2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS**

- A. Quartz Agglomerate: basis of design: Quantra Quartz Solid Sheets 2CM thick. Architect to select from full product line of patterns and colors.

### **2.2 COUNTERTOP FABRICATION**

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  - 1. Grade: Custom.
- B. Configuration:
  - 1. Front: Straight, slightly eased at top with separate apron.
  - 2. Backsplash: Straight, slightly eased at corner.
  - 3. End Splash: Matching backsplash.
- C. Countertops: 1/2-inch thick, quartz agglomerate with front edge built up with same material.
- D. Backsplashes: 1/2-inch thick, quartz agglomerate.
- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
  - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops without joints.
- G. Joints: Fabricate countertops in sections for joining in field.
  - 1. Joint Locations: Not within 18 inches of a sink and not where a countertop section less than 36 inches long would result, unless unavoidable.
  - 2. Joint Type: Bonded, 1/32 inch or less in width.
  - 3. Joint Type: Grouted, 1/16 inch in width.
  - 4. Joint Type: Sealant filled, 1/16 inch in width.
  - 5. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- H. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
    - a. Provide vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.
  - 2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
  - 3. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

### **2.3 INSTALLATION MATERIALS**

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install countertops level to a tolerance of 1/8 inch in 10 feet. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. 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.
- F. 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.
- G. 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.
- H. 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.
- I. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

**END OF SECTION 12 3661**

**SECTION 14 2000  
PASSENGER ELEVATORS**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Complete passenger elevator systems.
- B. Elevator maintenance.

**1.2 RELATED REQUIREMENTS**

- A. Section 08 3113 - Access Doors and Frames.
- B. Section 10 4400 - Fire Protection Specialties.
- C. Division 21 - Fire-Suppression Sprinkler Systems.
- D. Division 22 - Plumbing Equipment.
- E. Division 26 for Equipment Wiring.

**1.3 REFERENCE STANDARDS**

- A. AISC 360 - Specification for Structural Steel Buildings.
- B. ASME A17.1 - Safety Code for Elevators and Escalators.
- C. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks.
- D. NFPA 70 - National Electrical Code;
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- F. UL (BMD) - Building Materials Directory.
- G. UL (ECMD) - Electrical Construction Materials Directory.

**1.4 SUBMITTALS**

- A. Shop Drawings: Indicate the following information:
  - 1. Locations of machine room equipment: driving machines, controllers, governors and other component.
  - 2. Hoistway components: Car, counterweight, sheaves, machine and sheave beams, guide rails, buffers, ropes, and other components.
  - 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
  - 4. Individual weight of principal components; load reaction at points of support.
  - 5. Loads on hoisting beams and location of trolley beams.
  - 6. Clearances and over-travel of car and counterweight.
  - 7. Locations in hoistway and machine room of traveling cables and connections for car light.
  - 8. Location and sizes of access doors, doors, and frames.
  - 9. Expected heat dissipation of elevator equipment in machine room.
  - 10. Applicable seismic design data; certified by a licensed Professional Structural Engineer.
  - 11. Interface with building security system.
  - 12. Electrical characteristics and connection requirements.
  - 13. Show arrangement of equipment in machine room so rotating elements, sheaves, and other equipment can be removed for repairs or replaced without dismantling or removing other equipment components. Arrange equipment for clear passage through access door.
- B. Product Data: Provide data on the following items:
  - 1. Submit manufacturer/installer's product data, including installation instructions.
  - 2. Signal and operating fixtures, operating panels, indicators.
  - 3. Cab design, dimensions, layout, and components.
  - 4. Cab and hoistway door and frame details.
  - 5. Electrical characteristics and connection requirements.
- C. Samples: Submit manufacturer/installer's samples of standard colors and finishes of finish materials.
- D. Maintenance Contract.
- E. Maintenance Data: Include:
  - 1. Submit manufacturer's operation and maintenance manual with complete list of

- equipment replacement parts; identify each entry with equipment description and identifying code.
2. Technical information for servicing operating equipment.
  3. Legible schematic of hydraulic piping and wiring diagrams of installed electrical equipment and changes made in the Work. List symbols corresponding to identity or markings on machine room and hoistway apparatus.

## **1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with applicable code and as supplemented in this section.
- B. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a Professional Structural Engineer experienced in design of work of this type and licensed in the State in which the Project is located.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360, Specification for Structural Steel Buildings. Perform seismic design in accordance with applicable code.
- D. Fabricate and install door and frame assemblies in accordance with NFPA 80.
- E. Perform electrical work in accordance with NFPA 70.
- F. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- G. Installer Qualifications: Employees and supervisor on payroll of elevator equipment manufacturer.
- H. Regulatory Requirements:
  1. Elevator design, clearances, construction, workmanship, materials, and installation, unless specified otherwise, shall be in accordance with ANSI/ASME A17.1, handicap accessibility, American with Disabilities Act, and other codes having legal jurisdiction.
  2. ANSI/ASME A17.1 shall govern, except where codes having legal jurisdiction include more rigid requirements or conflict with ANSI/ASME A17.1.
  3. Elevator shall follow design and manufacturing procedures certified in accordance with ISO 9001-2000 to meet product and service requirements for quality assurance for new products.
- I. Products Requiring Fire Resistance Rating: Listed and classified by UL.
- J. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

## **1.6 WARRANTY**

- A. Provide one year manufacturer warranty for elevator operating equipment and devices.
- B. Manufacturer/installer shall guarantee materials and workmanship of equipment installed under these specifications and make good, defects not due to ordinary wear or to improper use, which may develop within one year after substantial completion of the building and owner occupancy.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturer: Basis of design: Thyssen Krupp – Endura 3 Stage 3500 Elevator
  1. 102 F.R.M. Up / 127 F.P.M. Down
- B. Elevator Components:
  1. Anti-stall feature.
  2. Braille and audible signals.
  3. Door open and close stall protection.
  4. Emergency lighting.
  5. Firefighter 's Service:
  6. Independent service feature.
  7. Infrared light curtain door protection.
  8. Low oil return.
  9. Overload sensors.



10. Phase protection.
  11. Soft Start Electronic Starting
  12. Locking Service Panel in Car Operating Panel.
  13. Pressure Switch.
  14. Remote Monitoring Capable.
  15. Telephone (ADA compliant).
  16. Battery Backup
  17. Wall Protection Pads
- C. Elevator Cab
1. Elevator Car Enclosure Wall Sections:
    - a. Cab Wall: Steel shell cab with plastic laminate vertical removable panels. Color to be selected by Architect from manufacturer's full range. Submit samples for selection.
    - b. Base, Frieze, and Reveals: To be selected by Architect from manufacturer's full range. Submit samples for selection.
  2. Ceiling:
    - a. Dropped Satin Stainless Steel Laminate Panels.
    - b. Lighting: 6-LED drop ceiling (FC-6).
  3. Cab Returns: Integral construction.
    - a. Finish: #4 stainless steel.
  4. Transoms:
    - a. Run full width of cab.
    - b. Finish: #4 stainless steel.
  5. Cab Doors:
    - a. Flush design both sides.
    - b. Rib construction.
    - c. Finish: #4 stainless steel.
  6. Exhaust Fan:
    - a. Single speed, 120 VAC fan mounted to ceiling to facilitate in-car air circulation. meeting A17.1 code requirements.
    - b. Mount in cab transom or canopy.
  7. Handrail:
    - a. Flat bar (DH-150) with a satin stainless-steel finish.
    - b. Mount on rear and sides walls.
  8. Threshold: Aluminum.
  9. Cab Finish Flooring: As selected by Architect.
    - a. Walk-off carpet to be provided by carpet supplier. See drawings for finish schedule.
- D. Hoistway Entrances
1. Hoistway Doors and Frames:
    - a. UL rated with required fire rating.
    - b. Doors: Rigid flush panel construction with sound-deadening material.
    - c. Frames: Securely fasten at corners to form unit frame. Frames shall be bolted.
  2. Exposed Areas of Corridor Frames: #4 stainless steel.
  3. Doors: #4 stainless steel.
  4. Sills: Aluminum on all floors.
- E. Cab Fixtures
1. Main Cab Operating Panel:
    - a. Mount in return.
    - b. Comply with handicap requirements.
    - c. Include pushbuttons and illuminating indications for each floor served.
    - d. Emergency Buttons and Switches: Provide in accordance with code.
    - e. Switches for car light and accessories.
  2. Cab Fixtures:
    - a. Car Lantern.
    - b. Digital Car Position Indicator.
    - c. Locking Service Panel in Car Operating Panel.

- d. Telephone (ADA compliant).
- F. Hall Fixtures
  - 1. Pushbuttons:
    - a. Up button and down button at intermediate floors.
    - b. Single button at each terminal floor.
    - c. Height: Comply with handicap requirements.
  - 2. Hall Fixture Finish: Black lexan.
  - 3. Fixture Cover Plates: Mount with tamper-resistant screws in same finish as fixture.

## 2.2 CONTROLS

- A. Door Controls:
  - 1. Program door control to open doors automatically when car arrives at a landing in response to a normal call or car call.
  - 2. Render "Door Close" button inoperative when car is standing at dispatching terminal with doors open.
  - 3. If doors are prevented from closing for approximately ten seconds because of an obstruction, automatically disconnect door reopening devices, close doors more slowly until obstruction is cleared. Sound buzzer.
  - 4. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equip with photo- electric light rays.
- B. Landing Buttons: Stainless steel type, one for originating UP and one for originating DOWN calls, one button only at terminating landings; marked with arrows.
- C. Landing Position Indicators: Illuminating white.
- D. Car Direction Indicators: Illuminating white.
- E. Interconnect elevator control system with building fire alarm systems.
- F. Provide "Firefighter's Operation" in accordance with applicable code. Designated Landing: 2.
- G. Control systems and controller are to be non-proprietary.
- H. Diagnostic Tools: Control systems requiring the use of proprietary, remote, hand-held, or other similar device or tools shall not be permitted. All diagnostic systems shall be accessible through an on board system using devices or tools readily available on the open market to experienced elevator maintenance personnel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine hoistways, hoistway openings, pits, and machine rooms before starting elevator installation.
- B. Verify existing conditions before starting work.
- C. Verify that hoistway, pit, and machine room are ready for work of this section.
- D. Verify walls and sill supports are plumb, where openings occur.
- E. Verify hoistway is clear and plumb, with maximum variation of 1/2 inch at any point.
- F. Verify minimum 2-hour fire-resistance rating of hatch walls.
- G. Verify hoistway shaft and openings are of correct size and within tolerance.
- H. Verify location and size of machine foundation and position of machine foundation bolts.
- I. Verify that electrical power is available and of the correct characteristics.
- J. Notify Architect in writing of dimensional discrepancies of other conditions detrimental to proper installation or performance of elevators.
- K. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to manufacturer.

### 3.2 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components.

### 3.3 INSTALLATION

- A. Install elevators in accordance with manufacturer/installer's instructions and ANSI/ASME A17.1.

- B. Install system components. Connect equipment to building utilities.
- C. Provide conduit, boxes, wiring, and accessories.
- D. Install hydraulic piping between cylinder and pump unit.
- E. Mount machines on vibration and acoustic isolators, on bed plate and concrete pad. Place on structural supports and bearing plates. Securely fasten to building supports. Prevent lateral displacement.
- F. Accommodate equipment in space indicated.
- G. Install guide rails using threaded bolts with metal shims and lock washers under nuts. Compensate for expansion and contraction movement of guide rails.
- H. Accurately machine and align guide rails. Form smooth joints with machined splice plates.
- I. Bolt brackets to inserts placed in concrete form work that will perform to four times the rated pull-out load.
- J. Coordinate installation of hoistway wall construction.
- K. Install hoistway door sills, frames, and headers in hoistway walls. Grout sills in place. Set entrances in vertical alignment with car openings and aligned with plumb hoistway lines.
- L. Fill hoistway door frames solid with grout.
- M. Structural Metal Surfaces: Clean surfaces of rust, oil or grease; wipe clean with solvent; prime two coats.
- N. Machine Room Components: Clean and degrease; prime one coat, finish with one coat of enamel.
- O. Adjust equipment for smooth and quiet operation.

### **3.4 ERECTION TOLERANCES**

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1.
- B. Cab Movement on Aligned Guide Rails: Smooth movement, with no objectionable lateral or oscillating movement or vibration.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing and inspection by regulatory agencies will be performed at their discretion.
  - 1. Schedule tests with agencies and notify Owner and Architect.
  - 2. Obtain permits required to perform tests.
  - 3. Document regulatory agency tests and inspections in accordance with the requirements of Section 01 4000.
  - 4. Perform tests required by regulatory agencies.
  - 5. Furnish test and approval certificates issued by authorities having jurisdiction.
- B. Perform testing and inspection in accordance with requirements of Section 01 4000.
  - 1. Perform tests as required by ASME A17.1 and governing codes.
  - 2. Provide two weeks written notice of date and time of tests.
  - 3. Supply instruments and execute specific tests.
- C. Perform operational tests in the presence of Owner and Architect.
- D. The Owner will test the control system of the elevators with their currently contracted maintenance staff or service provider to ensure that any experienced elevator maintenance company can service the elevator. Failure of this test constitutes defective work and shall be corrected at no cost to the Owner.

### **3.6 ADJUSTING**

- A. Adjust elevators for proper operation in accordance with manufacture/installer's instructions.
- B. Adjust for smooth acceleration and deceleration of car so not to cause passenger discomfort.
- C. Adjust doors to prevent opening of doors at landing on corridor side, unless car is at rest at that landing, or is on leveling zone and stopping at that landing.
- D. Adjust automatic floor leveling feature at each floor to achieve 1/4 inch from flush.
- E. Repair minor damages to finish in accordance with manufacturer/installer's instructions and as approved by Architect.
- F. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

### **3.7 CLEANING**

- A. Clean elevators promptly after installation in accordance with manufacturer/installer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.
- C. Remove protective coverings from finished surfaces.
- D. Clean surfaces and components ready for inspection.

### **3.8 PROTECTION**

- A. Do not permit construction traffic within cab after cleaning.
- B. Protect installed products until project completion.
- C. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

### **3.9 MAINTENANCE**

- A. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the elevator manufacturer or original installer.
- B. Provide service and maintenance of elevator system and components for one year from Date of Substantial Completion.
- C. Examine system components monthly. Clean, adjust, and lubricate equipment.
- D. Include systematic examination, adjustment, and lubrication of elevator equipment. Maintain hydraulic fluid levels. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original equipment. Replace wire ropes when necessary to maintain the required factor of safety.
- E. Perform work without removing cars during peak traffic periods.
- F. Provide emergency call back service at all hours for this maintenance period.

**END OF SECTION 14 2000**

**SECTION 14 9100  
FACILITY CHUTES**

**PART 1 GENERAL**

**1.01 GENERAL CONDITIONS**

- A. The General Conditions, Modifications to General Conditions, Supplementary or Special Conditions and any Instructions to Bidders shall apply to all Divisions of the work.
- B. The requirements of State, Local or appropriate codes applicable to the work, whichever is the most stringent is a requirement of all Divisions of the work.

**1.02 SECTION INCLUDES**

- A. Gravity chutes for waste (trash, refuse) and recyclables.
- B. Chute maintenance.

**1.03 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry
- B. Section 07 3113 - Asphalt Shingles
- C. Section 07 6200 - Sheet Metal Flashing and Trim
- D. Section 11 8227 - Waste Compactors
- E. Section 21 0500 – Common Work Results for Fire-Suppression
- F. Section 22 1120 - Plumbing Piping
- G. Section 26 2726 – Wiring Devices
- H. Section 28 4621 – Addressable Fire Alarm System

**1.04 REFERENCE STANDARDS**

- A. ASTM A463/A463M - Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process.
- B. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association.
- C. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; National Fire Protection Association.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene 7 days before start of installation to review code requirements, manufacturer's recommendations, and related work.

**1.06 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for additional requirements.
- B. Product Data: Manufacturer's printed data sheets on each component, indicating which options are provided.
- C. Shop Drawings: Detailed layout of chute and components, indicating interface with structure, enclosing walls, and utilities; show:
  - 1. Openings in floors and required clearances.
  - 2. Location and size of each field connection to structure.
  - 3. Pipe sizes and locations.
  - 4. Electrical wiring sizes, conduits, and location of connections.
  - 5. Clearly indicate components required but not furnished by chute installer.
- D. Reports: Submit for each test/inspection; see Section 01 4000 for requirements.
- E. Certificates: Certify that chute assembly meets or exceeds NFPA 82 and specified requirements.
- F. Maintenance Contract.
- G. Project Record Documents: Record actual locations of piping and electrical connections.
- H. Operation and Maintenance Data: Manufacturer's operation instructions.
  - 1. See Section 01 7800 for additional requirements.
  - 2. Include control wiring diagrams.

## 1.07 QUALITY ASSURANCE

- A. See Section 01 4000 Quality Requirements for additional requirements.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.
- C. Manufacturer Qualifications: Company specializing in making products specified in this section.
  - 1. With not less than three years of experience.
  - 2. With similar installation in satisfactory service for at least one year.
  - 3. Having a permanent service organization maintained or trained by manufacturer, that is able to provide service within 12 hours of receipt of notice that service is required.
- D. Installer Qualifications: Company specializing in performing the work of this section:
  - 1. With minimum 2 years of documented experience.
  - 2. Approved by manufacturer.

## 1.08 WARRANTY

- A. See Section 01 7800 Closeout Submittals for additional requirements.
- B. Correct defective work within a five-year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Chutes and Chute Components: Use one of the following:
  - 1. American Chute Systems
  - 2. Chutes International
  - 3. Cutler Manufacturing Corporation
  - 4. U.S. Chutes Corp.: [www.uschutes.com](http://www.uschutes.com).
  - 5. Substitutions: Not permitted.
- B. All components need not be made by the same manufacturer, provided manufacturer providing assembled units assumes responsibility for all components.

### 2.02 CHUTES

- A. Waste and Recyclables Chutes: Sheet metal, round, constant diameter extending from above roof to lowest floor, with intake doors at each floor and bottom outlet into room designated on drawings; complying with requirements of NFPA 82 and local code.
  - 1. Diameter: 24 inches (610 mm) inside.
  - 2. Intake Doors: Hopper type, no locks.
  - 3. Intake Door Size: 15 by 18 inches (380 by 450 mm) wide by high.
  - 4. Intake Door Operator: Foot pedal that unlatches and opens door.
  - 5. Interlock system and sensors that automatically prevent:
    - a. Opening more than one intake door at a time.
    - b. Opening any intake door when temperature in chute exceeds predetermined, adjustable temperature.
    - c. Opening any intake door when compactor is not ready to accept waste.
  - 6. Manual controls to activate spray cleaning from discharge room.

### 2.03 COMPONENTS

- A. Chute: Factory-fabricated to the greatest extent possible, with continuously welded or lock-seamed joints and smooth, non-snag interior (no protruding bolts, rivets, hardware, sharp edges or corners).
  - 1. Material: Aluminum-coated steel sheet complying with ASTM A463/A463M CS Type B, with minimum T1-40/T1M-120 coating.
  - 2. Sheet Metal Thickness: 16 gage, 0.06 inch (1.5 mm).
  - 3. Chute Offsets: Reinforced with additional layer of sheet metal at impact zones.
  - 4. Throat Sections: Provide sloped throat sections for intake doors, of same material and construction as chute.
  - 5. Factory-coat outside of chute with sprayed sound-dampening material.
  - 6. Fabricate with support frames at each floor with sound isolator pads and expansion joints in chute between each support point.

7. Horizontal Outlets: Provide painted steel leg braces to floor to withstand impact of material on bottom of chute.
- B. Intake Doors: Factory-assembled door and frame, self-closing and positive-latching; frame designed for chase construction, flush-mounted.
  1. Material: Stainless steel, brushed or satin finish.
  2. Fire Rating: 1-1/2 hour ("B" label) with 30-minute temperature rise of 250 degrees F (121 degrees C).
  3. Pulls: T-handle latch; polished stainless steel.
  4. Signs: Mark on frame or door face the purpose of the chute, using engraving, integral raised lettering, or other permanent signs.
- C. Discharge Doors: Aluminum-coated steel; normally-open, 1-hour ("B" label) fire rated, with fusible link closing; style as required by chute configuration.
  1. Vertical Discharge Style: Inclined horizontally rolling shutter.
  2. Horizontal Discharge Style: Top-hinged, drop-down, self-latching, in horizontal housing with 2 inch NPS (50 DN) piped drain connection in bottom.
- D. Access Doors: Same construction and fire rating as intake doors, with locks; provide wherever equipment requiring maintenance is located inside chute, including sprinklers and plumbing and electrical connections.
- E. Roof Vent: Full diameter, extending minimum 36 inches (915 mm) above roof level, with roof deck flange.
  1. Material: Manufacturer's standard.
  2. Counterflashing and clamping ring of non-ferrous metal compatible with chute material.
  3. Top Unit: Screened vent.
- F. Fire Sprinklers: Comply with NFPA 82 and NFPA 13; provide 1/2 inch NPS (15 DN) sprinkler heads mounted inside chute intake throats at the following locations:
  1. At or above the top intake opening.
  2. At the lowest intake opening.
  3. At locations as indicated on drawings.
- G. Electrical Controls: 110 V AC.
- H. Insulation: Fiberglass batt or blanket insulation, minimum 4 inches (100 mm) thick, without facings.

## **PART 3 EXECUTION**

### **3.01 COORDINATION**

- A. Complete chute installation and testing before completion of enclosing construction.
- B. Coordinate sprinkler and spray cleaning devices with size, location and installation of service utilities.
- C. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

### **3.02 INSTALLATION**

- A. Install chutes and equipment in accordance with NFPA 82 requirements and manufacturer's instructions.
- B. Maintain fire-resistive capacity of enclosing walls.
- C. Install chute plumb and without offsets or obstructions that might prevent free fall of materials, except where indicated on drawings.
- D. Anchor securely in manner required to withstand impact and weight of materials in chute.
- E. Wrap chute and intake throats with insulation, securing without compressing insulation.
- F. Install roof vent flange to roof deck prior to installation of roofing.
- G. Install counterflashing after roofing installation.
- H. Adjust doors and other operating components for smooth operation.

### **3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 Quality Requirements for additional requirements.
- B. Place bagged material of expected size in chute to verify free fall.
- C. Test all components for proper operation.

1. Operate doors, locks, and interlocks.
2. Operate spray cleaning devices.
3. Simulate fire conditions inside chute to verify sprinkler and detector operation.

**3.04 CLEANING**

- A. After completion of enclosing walls, clean exposed chute components; do not remove testing agency labels.

**3.05 MAINTENANCE**

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of chute and equipment for one year from Date of Substantial Completion.

**END OF SECTION 14 9100**



**SECTION 21 0500  
COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 - GENERAL**

**1.1 GENERAL REFERENCE**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 01 Specification sections, apply to work of this section.
- B. This Contractor is also referred to the Plumbing, Architectural, Structural, Electrical and all other drawings and specifications pertinent to this project. All of the above mentioned drawings and specifications are considered a part of the Contract Documents.
- C. This section specifies the basic requirements for Fire Suppression installations and includes requirements common to more than one section of Division 21. It expands and supplements the requirements specified in sections of Division 01.

**1.2 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.
- H. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 21 shall be defined as the subcontractor who is responsible for the work specified or indicated. All subcontracted work must be incorporated by and coordinated by the prime contractor.
- I. Throughout this specification section the term "Design Professional" is referenced. The specification calls for certain actions to be undertaken or referred to the Design Professional. Accordingly, the term "Design Professional" shall be defined as the firm with which the "Owner" has contracted to produce the contract drawings and specifications. It shall be understood that the Design Professional for this project is the Architect whose name is shown on the drawing title block.

**1.3 QUALITY ASSURANCE**

- A. Electrical Characteristics for Fire Protection 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 at the expense of the Fire Protection contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

- B. UL and FM Compliance: Fire protection system materials and components shall be Underwriter's Laboratories listed and labeled, and Factory Mutual approved for the application anticipated. Associate shall verify Factory Mutual requirements since their requirements may be stricter than the Ohio Basic Building Code and NFPA.

#### **1.4 FIRE SUPPRESSION COORDINATION**

- A. This Contractor shall familiarize himself with the work to be done under other Divisions of this specification and their related drawings and shall so coordinate and schedule his work as not to cause delays or interference with the work of others. Such coordination and scheduling shall accomplish the installation of equipment and piping with a minimum of cutting through masonry and other adjustments.
- B. Ceiling grid systems shall not be supported from fire protection lines or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure-concrete, steel or masonry.
- C. This Contractor shall be responsible for proper size and location of anchors, chases, recesses, openings, etc., required for the proper installation of his work. Verify all dimensions by field measurements. Coordinate the installation of required supporting devices and sleeves in structural components as they are constructed. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the work.
- D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- E. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors.
- F. Coordinate requirements for access panels and doors for fire protection items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- G. Allow ample space for removal of all parts that require replacement or servicing. Extend all grease fittings to an accessible location. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with a minimum of interference with other installations. Sequence, coordinate, and integrate installations of fire protection materials and equipment for efficient flow of the work.
- H. All fire suppression equipment, especially piping, shall be at least three feet away horizontally from any electrical switchgear or transformers. No hydronic lines shall pass through telephone, transformer, switchgear rooms or elevator equipment rooms.
- I. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- J. Specific divisions of responsibility when coordinating with trades other than fire suppression shall be as indicated on drawings, in Division 01, and as follows. The Contractors under this Division shall:
  - 1. Run the indicated utilities outside the building to points as noted on the drawings. He shall be responsible for the actual tie-in to street utility services where routing to site utility services on drawings pertaining to this Division are indicated.
  - 2. Provide and place all sleeves in floors, walls, etc., and coordinate such location.
  - 3. Rough-in and connect all equipment furnished by other trades or Owner where shown on the drawings.
  - 4. Provide motors, special controls, transformers and relays as required for the proper operation of all equipment furnished by him under this Division.
  - 5. Coordinate the location of floor drains and cleanouts with architectural and structural elements or work of other trades affecting the location of floor drains and cleanouts. Where floor drains are installed to serve specific pieces of equipment, coordinate the location of floor drains with the contractor who is providing the equipment, using manufacturer's shop drawings for the equipment served or written instructions from the equipment manufacturer.

## 1.5 EXAMINATION OF SITE

- A. Before submitting a bid, the Contractor is requested to visit the job site to familiarize himself with construction conditions. No consideration or remuneration will be given for his failure to do so.

## 1.6 DIVISION 21 DESIGN DOCUMENTS

- A. Should it appear that there is a discrepancy between or within the drawings and/or specifications concerning the nature, quality or extent of materials or work to be furnished and/or installed, and such discrepancy is not clarified by Addendum during the bidding period, this Contractor shall base his bid on performing the work in the manner having the higher cost. The Design Professional shall have the option of selecting either of the manners shown and/or specified. In the event the lower cost manner is selected, a credit shall be due the Owner in the amount of the difference between the lower cost and higher cost manner. Any discrepancies shall be called to the attention of the Design Professional before proceeding with work affected thereby.
- B. Where a discrepancy exists within the specifications, among the drawings, or between the specifications and the drawings, refer to project supplementary conditions.
- C. Should it appear that there is a duplication on the drawings or in the specifications, wherein the same work or items are shown or specified as being provided under separate subcontracts or supply orders, and such duplication is not clarified by addendum during the bidding period, it shall be assumed that the responsible prime contractor will select and coordinate which subcontract will supply the item and the item will be supplied as indicated. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on Plumbing plans and Division 22 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all applicable plumbing work in his bid.
- D. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, piping and ductwork unless dimensions are given. Drawings are not to be scaled.
  - 1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instructions.
    - a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.
    - b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.
  - 2. Piping is to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional offset and fittings shall be provided as necessary to meet space constraints and to facilitate the work of other trades.
    - a. Recognizing the potential need for additional offsets and fittings in piping, the Engineer has included a safety factor in all friction calculations. The Contractor is advised to plan and coordinate his work carefully to minimize the need for additional offsets and fittings. The Contractor shall be responsible to notify the Engineer of any and all modifications to systems which may affect the ability of equipment to serve its intended use prior to the purchase and installation of such equipment.
- E. All equipment, piping and material specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.

- F. If this Contractor proposes to install equipment requiring space conditions other than those as specified and/or shown on the design drawings, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall obtain the full approval of the Design Professional before proceeding with the work.

### **1.7 RECORD DOCUMENTS**

- A. Prepare record documents in accordance with the requirements of this division, and in Division 01.
- B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of prints. Changes shall be accurately dimensioned and/or drawn to scale.
- C. This Contractor shall keep an updated set of specifications and prints, including changes on the job site, at all times and shall submit one (1) set of updated and legible prints to the Design Professional when the work is complete.

### **1.8 SHOP DRAWINGS**

- A. Refer to the conditions of the Contract (General and Supplementary) and Division 01 Section: Shop drawings, product data, and samples for submittal definitions, requirements, and procedures. Refer to project schedule for required submission dates.
- B. Submit electronic copy of shop drawings to the Design Professional.
- C. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information required by the contract documents. Shop drawings not stamped with Contractor approval will be returned for reprocessing.
  - 1. Shop drawings shall only cover equipment or components that are being provided. Failure to edit shop drawings and options will be reason for rejection.
  - 2. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.
  - 3. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.
  - 4. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.
  - 5. Equipment shop drawings shall include nameplate data, model number and efficiency rating along with full load amps for all electrical motors.
  - 6. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.
- D. In checking shop drawings, the Design Professional will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.

### **1.9 EQUIPMENT**

- A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that the manufacturer of all parts of the equipment offered have been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.

- B. When two or more items of same equipment are required (pumps, valves, etc.) they shall be of the same manufacturer.
- C. In placing his bid, the Contractors under this Division shall take note that manufacturer's products change frequently, and only the scheduled products have been checked by the Engineer for compliance with the Contract Documents and physical characteristics. Other manufacturers are listed because they are believed to be capable of complying, and in order to achieve fair and competitive bidding. However, it is the responsibility of the manufacturer in his relationship with the Contractor to bid to the Contractor only products complying with the Contract Documents, and the responsibility of the Contractor to base his bid only on manufacturers which do comply. No consideration will be given to the Contractor for his failure to do this. Should Contractors during the bidding process discover that listed manufacturers cannot comply with the Documents, they are encouraged to contact the Engineer as soon as practical, and provided sufficient time in the bidding process exists, and the Engineer agrees with the request, the Engineer will attempt to adjust the documents in the addendum process. If no addendum is issued adjusting the requirements so that all listed manufacturers can bid, the Contractor will be required to supply one of the listed manufacturers which comply with the Contract Document requirements.

#### **1.10 SUBSTITUTIONS**

- A. Refer to the Instructions to Bidders and the related Division 01 sections for requirements in selecting products and requesting substitutions.
- B. Bids concerning the use of substitute products must be accompanied by complete specifications and performance characteristics covering these products, together with such available test data and experience records as may be helpful to the Design Professional in evaluating the quality and/or suitability of the proposed products.
- C. The intent of this paragraph is to make the specifications open to all available makes of material and apparatus during the bidding period. Certain definite makes or kinds of items are specified as "standards of quality" and character required. Each Contractor is required to bid upon the basis of furnishing the makes specified. He is also invited to bid on any other similar makes he (the Contractor) may desire to propose as substitutions, stating any difference in cost for each proposed substitution on the Substitution Sheet, if there is a difference. If the Design Professional shall decide to accept any of the proposed substitutions, proper notations thereof shall be made in the written contract. Where several makes are mentioned in the specifications and the Contractor fails to state that he prefers a particular make in his bid, the Owner shall have the right to choose any of the makes mentioned without change in price. No consideration will be given to proposals for alternative products unless submitted with the original bids.

#### **1.11 SUPERVISION**

- A. The Fire Suppression Contractor shall have in charge of work at all times during construction, a competent foreman or superintendent whose experience and background shall qualify him for the work to be performed under this division. Once assigned, the foreman or superintendent shall be retained until completion of the project and any consideration as to his removal on grounds of incompetence shall either be initiated by or referred to the Design Professional for decision. Contractor is to provide a resume for the superintendent/foreman with prior approval by the owner.

#### **1.12 CODES AND PERMITS**

- A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.

- B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any requirements of specifications which are in excess of Code requirements and not in conflict therewith.
- C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for work performed by them in connection with provision of service connections required under this DIVISION of specifications. Deliver all certificates to Design Professional in duplicate.
- D. The contractor shall be required to comply with OSHA requirement for physical hazards, safety equipment, fire fighting equipment and protective equipment.
- E. Belt guards, coupling guards, rails, roof fall protection, etc. shall be provided to meet OSHA requirements. Vent shafts and vertical openings shall be enclosed and comply with all OSHA requirements.

### **1.13 INTERFERENCES**

- A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Design Professional may direct to permit completion of Architectural work in accordance with plans and specifications.
- B. Install additional offsets on piping where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install fire suppression services and overhead equipment to provide the maximum headroom possible.
- C. Report any interferences between work under this division and that of any other Contractors to the Design Professional as soon as they are discovered. The Design Professional will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

### **1.14 SHOP AREAS AND MATERIAL STORAGE**

- A. No fire suppression related trade is permitted to use as shop working area, any concrete slab that is to receive metallic waterproofing, asphalt tile, plastic tile, etc., except by express permission of the Design Professional.
- B. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight. Stored piping, and equipment to be covered and sealed at all open ends.

### **1.15 CLEAN-UP**

- A. Refer to the Division 01 for general requirements for project cleaning. Contractor is responsible for cleaning each day.
- B. Insofar as the Fire Suppression work is concerned, at all times keep premises and building in neat and orderly condition, follow explicitly any instructions of Design Professional in regard to storing of materials, protective measures, cleaning-up of debris, etc.
- C. Upon completion of work, this Contractor shall thoroughly clean all apparatus furnished by him, pack all valves and thoroughly clean piping, ductwork and equipment removing all dirt, grease and oil.

- D. All equipment to be thoroughly cleaned prior to startup.

#### **1.16 OPERATING AND MAINTENANCE**

- A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 21 specification sections in the proper operation of the fire suppression equipment. He shall also supply the Owner with three (1) hardbound copies of an operation manual bound in a transparent vinyl sleeve on the front of the binder and binder edge to protect labeling and (1) electronic copy in "PDF" format on disk. The manual shall be labeled on the front as well as the binder with the project name, project number, and the trade covered (i.e. "Fire Suppression", etc.). The operating and maintenance manual shall include the following:
  - 1. Cover sheet with project name, number, and contractor.
  - 2. Contractor and sub-contractor contact and phone list.
  - 3. Contractor warranty, indicating date of final acceptance and expiration.
  - 4. Equipment and material warranties and guarantees.
  - 5. Contact names and phone numbers for each product.
  - 6. Table of contents.
  - 7. Tabbed sections for each topic included in the manual.
  - 8. Complete equipment list with model and serial number.
  - 9. Manuals shall indicate all local suppliers of equipment.
  - 10. Step-by-step procedures for start-up and shutdown for each system and piece of equipment.
  - 11. Performance data, curves, ratings.
  - 12. Wiring diagrams.
  - 13. Manufacturer's descriptive literature.
  - 14. Automatic controls with diagrams and written sequence of operation.
  - 15. Manufacturer's maintenance and service manuals.
  - 16. Spare parts and replacement parts list for each piece of equipment.
  - 17. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
  - 18. Final approved shop drawings indicating actual device/equipment provided, not generic product data.
  - 19. Final approved balance reports.
  - 20. Final Operating parameters (Pressures, GPM etc.).

#### **1.17 WARRANTIES**

- A. Refer to the Division 01 Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.
- B. Furnish to owner two (2) hard copies and (1) electronic in "PDF" format along with contact names, phone numbers, and email address for each product.
- C. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Design Professional, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 21 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

#### **1.18 TEMPORARY SERVICES**

- A. The Contractor under this division shall provide temporary services, i.e.: as specified herein or in Division 01 "General Conditions" and "Special Conditions" portions of this specification.

### **1.19 PROTECTION OF WORK AND PROPERTY**

- A. The Contractor shall be responsible for safeguarding work, property and facilities against damage, both his own as well as others, with which he may come into contact in the performance of his work.
- B. Stored materials shall be protected against damage from weather. Pipe openings shall be closed with caps or plugs during installation. All fixtures and equipment shall be covered and protected against injury. Any materials or equipment damaged at any stage in the construction shall be replaced or repaired, and at the final completion of all work shall be in a clean, unblemished condition.

### **1.20 CUTTING AND PATCHING**

- A. Refer to the Division 01 Section: CUTTING AND PATCHING for general requirements for cutting and patching.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching. Arrange for repairs required to restore other work, because of damage caused as a result of fire suppression installations. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- C. The contractor under this division shall perform cutting, fitting, and patching of building components and fire suppression equipment and materials required to:
  - 1. Uncover Work to provide for installation of ill-timed Work;
  - 2. Remove and replace defective Work;
  - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
  - 4. Remove samples of installed Work as specified for testing;
  - 5. Install equipment and materials in existing structures;
  - 6. Upon written instructions from the Design Professional, uncover and restore Work to provide for Design Professional observation of concealed Work.
- D. See other sections of this specification for demolition requirements.
- E. Pipe holes in floors and walls shall be core drilled if not sleeved during construction.

## **PART 2 - PRODUCTS (Not Applicable to this Section)**

## **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. 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 piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping 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.

### **3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.3 TESTS AND ADJUSTMENTS**

- A. Upon completion of the erection of all equipment and all work specified herein and/or shown on approved drawings, or at such times as directed by the Design Professional, this Contractor shall start all apparatus, make necessary tests as directed and as specified herein and make complete adjustments of all items of equipment before acceptance by the Design Professional to whose representative this Contractor shall demonstrate (by performance) all of the various apparatus and equipment.
- B. When the Contractor is ready to run capacity tests, he shall notify the Design Professional. When this notice is given, the Design Professional will assume that the Contractor has made preliminary tests and is satisfied that the plant will develop specified and guaranteed capacities. It will be the Contractor's responsibility to furnish any and all instruments required to obtain test data which shall include thermometers, electric meters, pressure gages, etc.
- C. Work under this division of the specifications shall not be considered complete until the Contractor has obtained required inspection, performance tests, made necessary adjustments and has submitted satisfactory evidence of compliance. The Design Professional or his representative will make spot checks to determine the accuracy and completeness of final adjustments. Should spot checks indicate more than a reasonable deviation from design requirements, the Contractor shall repeat tests and adjustments to the satisfaction of the Design Professional.

### **3.4 PUNCLISTS**

- A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional.

**END OF SECTION 210500**

**SECTION 21 0501  
BASIC MECHANICAL MATERIALS AND METHODS FOR FIRE PROTECTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. Requirements specified in Division 21 Section "Common Work Results for Fire Protection" apply to this section.
- C. Requirements of Division 03 specification sections apply to work of this section.

**1.2 DESCRIPTION OF WORK**

- A. Extent of Fire Protection related work required by this section is indicated on drawings and/or specified in other Division 21 sections.
- B. Furnish and install all miscellaneous steel required for supports, hangers, anchors, guides, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a moist environment shall be hot dipped galvanized unless otherwise noted.

**1.3 QUALITY ASSURANCE**

- A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Concrete Work Codes and Standards: Comply with governing regulations and, where not otherwise indicated, comply with industry standard, in its application to work in each instance.
- C. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

**1.4 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including the recommended installation method, all in accordance with Division 01 and Section 210500 requirements.

**PART 2 - PRODUCTS** – Not applicable this section.

**PART 3 - EXECUTION**

**3.1 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

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

**END OF SECTION 21 0501**

**SECTION 21 0517  
SLEEVES AND SLEEVE SEALS FOR FIRE SUPPRESSION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Sleeves.
  - 2. Sleeve-seal systems.
  - 3. Grout.
  - 4. Silicone sealants.
  - 5. Mechanical System Sound Stopping.
  - 6. Mechanical System Penetration Seals.

**1.3 DESCRIPTION OF WORK**

- 1. Furnish and install sound stopping around penetrations or mechanical materials and equipment.
- 2. Furnish and install fire and smoke penetration seals around penetrations of mechanical materials and equipment through fire or smoke barriers, floors and foundation walls.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Fire and Smoke Sealers: For each type of installation provide corresponding assembly detail complying with the current NFPA, ASTM E814, and by Underwriters Laboratory requirements.
- C. Mechanical System Penetration Seals (Firestopping): Submit the following:
  - 1. Shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.
  - 2. A copy of UL illustration of each proposed system indicating manufacturer approved modifications.
  - 3. Manufacturer's specifications, recommendations, installation instructions and maintenance instructions.
  - 4. Tested firestop systems engineering judgement.

**1.5 QUALITY ASSURANCE**

- A. The firestopping systems are to be installed by experienced, manufacturer trained, and UL certified or FM certified personnel.
- B. All firestopping material is to be provided from a single manufacturer for all applications.
- C. Consult manufacturer's technical experts for assistance in selective appropriate firestop system for each application.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. Molded non-conductive, high impact resistant HDPE sleeves (for installations less than 150°F) similar to Proline CS – Century Line Sleeve or Westlantic Tech Corp Wall Sleeves WA. Provide with puddle flange (water stop ring) configuration for mechanical sleeve seal installations.

### 2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Flexicraft.
  - 4. Link-Seal / Thunderline Corp. / Garlock Piping Technology.
  - 5. Metraflex Company (The).
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20-psig.
  - 3. Sealing Elements: EPDM-rubber for systems up to 250°F interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size. Pressure plates to be composite plastic.
  - 4. Sealing Elements: High-temperature-silicone for systems up to 400°F with interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size. Pressure plates to be coated carbon steel.
  - 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.
  - 6. Concrete Wall Penetrations: All concrete wall penetration sleeves shall have a puddle flange (water stop ring) configuration.

### 2.3 GROUT

- A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.4 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, mildew resistant, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, use NT.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer.
- B. Install sleeves accurately centered on pipe runs.
- C. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but no less than 2 pipe sizes larger than piping run.
- D. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for insulation installation.
- E. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 2" above level floor finish, 3/4" above floor finish sloped to drain, and flush with floor in other areas.
- F. Provide temporary support of sleeves during placement of concrete and other work around sleeves and provide temporary closure to prevent concrete and other materials from entering sleeves.
- G. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- H. 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.
- I. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- J. Install sleeves for pipes passing through interior partitions and slabs as they are constructed.
  - 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 sealants appropriate for size, depth, and location of joint.
  - 4. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  - 5. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
  - 6. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
    - a. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
    - b. Seal space outside of sleeve fittings with grout.

7. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
  - a. Refer to Division 07 Section "Joint Sealants" for materials and installation.
  
- K. 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.
  
- L. 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.
  
- M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
  1. Refer to Division 07 Section "Penetration Firestopping" for materials.
  
- N. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

### **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 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
  
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

### 3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls Above Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron sleeves.
    - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.
  - 2. Exterior Concrete Walls Below Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe or high density polyethylene sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron pipe or high density polyethylene sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Piping Smaller Than NPS 6: Cast-iron pipe or high density polyethylene sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
    - b. Piping NPS 6 and Larger: Cast-iron pipe or high density polyethylene sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs Above Grade:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Steel pipe sleeves.
  - 5. Interior Partitions:
    - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

### 3.5 FIRE PROTECTION SYSTEM SOUND STOPPING

- A. Where pipes or ducts or other components of Division 21 work pass through non-fire rated walls or floors, but walls which extend from horizontal structure to structure, provide sound stopping between such mechanical work and the building structure intended to reduce the transmission of sound from one side of the wall to the other.
- B. Sound stopping of pipes in sleeves shall consist of sealing the outside of the sleeve with caulking and the inside with an insulating material.
- C. Sound stopping of pipes or ducts without sleeves shall consist of packing the cavity around the penetration with an insulating material and sealing the opening with approved sealant or plaster.
- D. Insulating materials shall be non-asbestos and non-friable, and shall have a flame spread rating of no more than 25 and a smoke developed rating of no more than 50.

### 3.6 FIRE PROTECTION SYSTEM PENETRATION SEALS

- A. Where pipes or ducts or other components of Division 21 work pass through fire or smoke rated walls or floors, provide non-asbestos seal assemblies classified by UL to provide fire barriers equal to the time rating of the construction being penetrated, with materials that comply with applicable codes and that have been tested in accordance with UL 1479 or ASTM E-814.
- B. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with manufacturer's instructions. Seal all holes or voids made by penetrations. Where floor openings without penetrating items are more than four

inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.

- C. The contractor shall provide submittal data on each installation type for approval by the Associate.
- D. Fire and smoke sealing systems shall be tested in accordance with the appropriate current NFPA ASTM E 814 and by Underwriters Laboratories requirements.
- E. All materials shall be non-asbestos containing.
- F. All firestop material shall be painted to match adjacent wall surfaces in visible public spaces.
- G. Hold a pre-installation meeting with General associated trades and Owner. Review contractor inspection guidelines.

**END OF SECTION 21 0517**



**SECTION 21 0518  
ESCUTCHEONS FOR FIRE SUPPRESSION PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

**1.3 DEFINITIONS**

- A. **Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise** indicated to be removed, removed and salvaged, or removed and reinstalled.

**1.4 ACTION SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.1 ESCUTCHEONS**

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
- D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed rivet hinge; and spring-clip fasteners.

**2.2 FLOOR PLATES**

- A. Split Floor Plates: Steel with concealed hinge.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall:
      - 1) One-piece, deep pattern with spring-clip fasteners.
    - b. Chrome-Plated Piping:

- 1) One-piece cast brass.
- c. Insulated Piping:
  - 1) One-piece steel or cast brass.
  - 2) Split-plate, stamped steel or cast brass with concealed hinge.
- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces:
  - 1) One-piece steel or cast brass.
  - 2) Split-plate, stamped steel or cast brass with concealed hinge.
- e. Bare Piping at Ceiling Penetrations in Finished Spaces:
  - 1) One-piece steel or cast brass.
  - 2) Split-plate, stamped steel or cast brass with concealed hinge.
- f. Bare Piping in Unfinished Service Spaces:
  - 1) One-piece steel or cast brass.
  - 2) Split-plate, stamped steel or cast brass with concealed hinge.
- g. Bare Piping in Equipment Rooms:
  - 1) One-piece steel or cast brass.
  - 2) Split-plate, stamped steel or cast brass with concealed hinge.
- 2. Escutcheons for Existing Piping to be split-plate, stamped steel with concealed hinge for the following:
  - a. Chrome-Plated Piping.
  - b. Insulated Piping.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces.
  - d. Bare Piping at Ceiling Penetrations in Finished Spaces.
  - e. Bare Piping in Unfinished Service Spaces.
  - f. Bare Piping in Equipment Rooms.
- 3. Escutcheon Finishes:
  - a. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with inside diameter to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: Split floor plate.
  - 2. Existing Piping to Remain: Split floor plate.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

## PART 4 - SUPPLEMENTAL REQUIREMENTS

### 4.1 SUPPLEMENTAL REQUIREMENTS

- A. General: Provide pipe escutcheons on all pipes passing through floors and all pipes passing through walls or ceilings in exposed areas with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas including Equipment Rooms: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide chrome plated sheet steel escutcheons, solid or split hinged.

- D. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole and is flush with adjoining surface.

**END OF SECTION 21 0518**

**SECTION 210519  
METERS AND GAGES FOR FIRE SUPPRESSION PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Dial-type pressure gages.
  - 2. Gage attachments.
- B. Related Requirements:

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of meter and gage.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 DIAL-TYPE PRESSURE GAGES**

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  - 1. Standard: ASME B40.100.
  - 2. Case: Liquid-filled drawn steel on all vibrating equipment; minimum 4-1/2" diameter above 6'-0" above floor, 3-1/2" below 6'-0" above floor.
  - 3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  - 4. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  - 5. Movement: Mechanical, with link to pressure element and connection to pointer.
  - 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
  - 7. Pointer: Dark-colored metal.
  - 8. Window: Plastic.
  - 9. Ring: Stainless steel.
  - 10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## **2.2 GAGE ATTACHMENTS**

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4, ASME B1.20.1 pipe threads.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- B. Install valve and snubber in piping for each pressure gage for fluids.
- C. Install pressure gages in the following locations:
  - 1. Inlet and discharge of each pressure-reducing valve.
  - 2. Suction and discharge of each pump.

### **3.2 CONNECTIONS**

- A. Install gages adjacent to machines and equipment to allow space for service and maintenance of meters, gages, machines, and equipment.

### **3.3 ADJUSTING**

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of gages to proper angle for best visibility.

### **3.4 PRESSURE-GAGE SCHEDULE**

- A. Gages installed with improper ranges will be required to be replaced by the contractor at no additional costs after system commissioning is complete.

### **3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE**

- A. Scale Range for Fire Suppression-Water Piping:
  - 1. 0 to 160 psi.

## **PART 4 - SUPPLEMENTAL REQUIREMENTS:**

### **4.1 PRESSURE GAUGE INSTALLATION**

- A. All gauges to be rated for fluid applications with expected operating pressure to fall in the middle of the pressure range
- B. Gauges shall include isolation ball or gate valve (steam), schedule 80 nipples, fittings and pipe. Provide tee fitting between isolation valve and gauge.
- C. Pressure gauges shall be located in the following locations (minimum):
  - 1. Suction and discharge of pumps.
  - 2. Fire protection systems including limited area systems connected to potable water.
  - 3. Upstream and downstream of main building backflow devices, i.e. fire system double check and domestic water RPB (RPZ).

**END OF SECTION 21 0519**

**SECTION 210529**  
**HANGERS AND SUPPORTS 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. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.
  - 8. Roof equipment supports.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support. For equipment curbs supply manufacturer's certified load bearing data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support, indicating dimensions, weights, required clearances, and methods of assembly of components.

**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, Section IX.
- C. Codes and Standards:
  - 1. Code Compliance: Unless requirements are exceeded herein, comply with applicable codes pertaining to product materials and installation of supports and anchors. For Ohio projects, follow the State Architect's "Handbook of Instruction" and Ohio Basic Building Code for maximum hanger spacing requirements.
  - 2. Comply with NFPA 13 for hangers and supports used as components of fire protection systems. Include listing and labeling by UL and FM.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS OF HANGERS AND SUPPORTS:**

- A. Manufacturer: All hanger systems shall be UL Listed.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Hangers and supports for Fire Suppression piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

### **2.3 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, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper, factory-fabricated components or nylon. Plated copper is not acceptable.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

### **2.4 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-58, 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.
- B. Cushion Clamps: UL Classified 2043 (25/50), Molded with high strength Thermoplastic Elastomer (TPE). Temperature rating: -65°F to 275°F. Clamps to be by Hydra-Zorb.

### **2.5 THERMAL-HANGER SHIELD INSERTS**

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with 100-psi ASTM C 552, Type II cellular glass with 100-psi minimum compressive strength.



- C. Insulation-Pipe Supports for Cold or Hot Piping: Where insulated piping is supported from unistrut or other similar systems, crush resistant insulation clamps similar to ZSI Cush-A-Therm, K-Flex® 360 Insulated Pipe Support, and Klo-Shure insulation couplings will be acceptable.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 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 anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-coated or stainless-steel.
  - 2. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  - 3. Hardware: Galvanized steel or polycarbonate.
  - 4. Accessories: Protection pads.
- C. Low-Profile, Single Base, Single-Pipe Stand:
  - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  - 3. Vertical Members: Two, galvanized (indoor applications) or stainless-steel (outdoor applications), continuous-thread 1/2-inch rods.
  - 4. Horizontal Member: Adjustable horizontal, galvanized (indoor applications) or stainless-steel (outdoor applications) pipe support channels.
  - 5. Pipe Supports: Roller, Strut clamps, Clevis hanger, or Swivel hanger as detailed on drawings.
  - 6. Hardware: Galvanized (indoor applications) or Stainless steel (outdoor applications).
  - 7. Accessories: Protection pads.
  - 8. Height: See details on drawings.
- D. High-Profile, Single Base, Single-Pipe Stand:
  - 1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Single vulcanized rubber or molded polypropylene.
  - 3. Vertical Members: Two, galvanized (indoor applications) or stainless-steel (outdoor applications), continuous-thread 1/2-inch rods.
  - 4. Horizontal Member: One, adjustable height, galvanized (indoor applications) or stainless-steel (outdoor applications) pipe support slotted channel or plate.
  - 5. Pipe Supports: Roller or Clevis hanger as detailed on drawings.
  - 6. Hardware: Galvanized (indoor applications) or stainless steel (outdoor applications).

7. Accessories: Protection pads, 1/2-inch continuous-thread galvanized-steel rod (indoor applications) , 1/2-inch continuous-thread stainless-steel rod (outdoor applications).
  8. Height: See details on drawings.
- E. High-Profile, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  2. Bases: Two or more; vulcanized rubber or molded polypropylene.
  3. Vertical Members: Two or more, galvanized (indoor applications) or stainless-steel (outdoor applications) channels.
  4. Horizontal Members: One or more, adjustable height, galvanized (indoor applications) stainless-steel (outdoor applications) pipe support.
  5. Pipe Supports: Roller, Strut clamps, Clevis hanger, Swivel hanger as detailed on drawings.
  6. Hardware: Galvanized (indoor applications) or Stainless steel (outdoor applications).
  7. Accessories: Protection pads, 1/2-inch continuous-thread rod.
  8. Height: See details on drawings.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.8 EQUIPMENT SUPPORTS

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

## 2.9 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Metal Framing: NEMA STD ML 1.
- G. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards. Material coatings for interior use shall be electro-plated zinc (ASTM B633), or mill galvanized (ASTM A525 G90). For exterior use, materials shall be hot-dip galvanized after fabrication (ASTM A386).
- H. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts and nuts. Use galvanized or stainless steel for use in moist environments.
- I. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Non-staining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 - EXECUTION**

### **3.1 INSPECTION:**

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### **3.2 PREPARATION:**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

### **3.3 HANGER AND SUPPORT INSTALLATION**

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washer and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support fire protection piping independently of other piping.
- D. Prevent electrolysis in support of copper tubing by use of copper or nylon clamps and supports which are copper or stainless steel, or by other recognized industry methods. Copper-plated clamps in direct contact with copper piping is not acceptable.
- E. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- F. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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.
- G. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- H. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- I. 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.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Provisions for Movement:
  - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
  - 2.

### **3.4 EQUIPMENT SUPPORTS**

- A. Provide painted structural steel stands to support equipment from structure overhead or to support equipment above floor.
- B. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.
- C. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- D. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.5 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.

### **3.6 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.

### **3.7 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: Comply with requirements in Section 210501 Basic Materials and Methods for Fire Suppression for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

### 3.8 HANGER AND SUPPORT SCHEDULE

- A. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- C. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- D. Use stainless-steel pipe hangers and stainless-steel attachments for outdoor and hostile environment applications.
- E. Use copper or nylon pipe clamps and copper or stainless-steel attachments for copper piping and tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type of one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Copper-plated clamps are not acceptable for copper-piping systems. Clamps in direct contact of copper piping to be copper or nylon. Provide felt lined hangers or clamps for uninsulated refrigerant piping to eliminate transmission of sound and vibration. Perforated strap hangers shall not be used in any work. 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 30.
  - 2. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
  - 4. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 5. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 6. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  - 8. 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 unnecessary.
- I. Vertical-Piping Clamps: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SSP-58, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Copper-plated clamps are not acceptable for copper-piping systems. Clamps in direct contact of copper piping to be copper or

nylon. Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, expansion shells, inserts or beam clamps selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information.
1. All beam clamps shall be installed with a retaining strap to grasp two opposing sides of structure to prevent possible movement of the clamp due to vibration.
  2. Select size of building attachments to suit hanger rods.
  3. Provide copper-plated building attachments for copper-piping systems.
  4. "C" clamps shall not be permitted except on fire protection piping.
  5. Install building attachments at required locations within concrete or on structural steel for proper piping support.
  6. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
    - a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
    - b. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
    - c. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
    - d. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
    - e. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
    - f. C-Clamps (MSS Type 23): For structural shapes.
    - g. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
    - h. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
    - i. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

- j. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
- k. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- l. 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:
  - 1) Light (MSS Type 31): 750 lb.
  - 2) Medium (MSS Type 32): 1500 lb.
  - 3) Heavy (MSS Type 33): 3000 lb.
- m. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- n. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- o. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- p. Space attachments within maximum piping span length indicated below. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. For new concrete, install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

- 1) Two or one-end threaded rod sizing for various support loads shall be as follows:

ROD DIAMETER	MAXIMUM LOAD (LBS.)
3/8"	610
1/2"	1130
5/8"	1810
3/4"	2710
7/8"	3770
1"	4960
1-1/8"	6230
1-1/4"	8000
1-1/2"	11630
1-3/4"	15700
2"	20700
2-1/4"	27200
2-1/2"	33500

Note limitations on structure supporting rods.

- 2) For reference purposes, the following table provides filled weights of steel piping for various sizes:

PIPE SIZE	FILLED PIPE WEIGHT (LB/FT)
1/2"	1.0
3/4"	1.4
1"	2.1
1-1/4"	3.0
1-1/2"	3.6
2"	5.1
2-1/2"	7.9
3"	10.8
4"	16.3

6"	31.5
8"	50.2
10"	74.6
12"	98.6

- L. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Piping support spacing:
  - 1. All piping shall be supported at distances not exceeding the spacing in the following table. This table is intended for general distribution piping. Within equipment rooms, hangers must be arranged to provide full support of piping. No piping is to be supported by, or impose a load upon the equipment to which it is connected. Install hangers for steel piping with the following maximum spacing and minimum rod sizes unless hanger spacing is:
    - a. Specifically indicated on drawings
    - b. Indicated in other Division 21 specification sections for special applications
    - c. Required to be more frequently by State or local codes
  - 3. Maximum steel piping hanger supports
    - a. NPS 3/4: Maximum span, 7 feet.
    - b. NPS 1: Maximum span, 7 feet.
    - c. NPS 1-1/2: Maximum span, 9 feet.
    - d. NPS 2: Maximum span, 10 feet.
    - e. NPS 2-1/2: Maximum span, 11 feet.
    - f. NPS 3 and Larger: Maximum span, 12 feet.
  - 4. Maximum drawn-temper copper piping hanger supports:
    - a. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
    - b. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
    - c. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
    - d. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    - e. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
    - f. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
    - g. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- P. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- Q. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- R. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- S. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- T. Horizontal Piping: Comply with the following installation requirements.
  - 1. Individual hangers for uninsulated piping not specified to be supported with roller hangers may be supported with either adjustable band hangers or adjustable steel clevis hangers.
  - 2. Individual hangers for insulated piping not specified to be supported with roller hangers shall be adjustable steel clevis hangers.
- U. Heavy duty trapezes may be utilized for multiple horizontal pipes where applicable. Design of same shall be by trapeze manufacturer considering weight, available structure, pipe medium,



material, etc. Supports for individual piping group on trapezes shall be as specified for individual piping.

**END OF SECTION 21 0529**

**SECTION 21 0553**  
**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. Pipe labels.
  - 3. Valve tags.
  - 4. Underground-type plastic line markers.
  - 5. Warning tags.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  - 6. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
  - 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
  - 8. Fasteners: Stainless-steel rivets or self-tapping screws.
  - 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. 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 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 cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: Size letters according to ASME A13.1 for piping. Abbreviate only as necessary for each application length.

## 2.3 VALVE TAGS

- A. Description: 1-1/2" diameter stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers. Numbers to be sequenced. The tag engraving shall be filled with black enamel.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Tag Material: Plastic, 3/32-inch minimum thickness engraved plastic laminate valve tags and having predrilled or stamped holes for attachment hardware.
  - 3. Fasteners: Brass wire-link chain, brass or stainless steel beaded chain, or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system service, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), equipment or area isolated, 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. For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with plastic (plexiglass) panel. Submit valve schedule for Engineer's review prior to mounting.

## 2.4 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: Approximately 4 by 7 inches.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature:
    - a. Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE".
    - b. For confined space identification: "Danger" with the words "Permit-Required Confined Space. Do Not Enter".

4. Furnish a quantity of 24 lockout tags, professionally pre-printed with the word "Danger" in white lettering on red background with the words "Do Not Start. Equipment Locked Out" following.
5. Color: Safety-yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### **3.2 GENERAL INSTALLATION REQUIREMENTS**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### **3.3 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Equipment labels shall be located where accessible and easily seen from the front of the equipment. When the equipment itself is not able to accept the label (i.e. pressure sensitive tape does not stick to the surface) the tag shall be mounted in an appropriate location on the wall. Equipment tags shall include such information as make, model, capacity, voltage, static pressure ratings, CFM, GPM, TDH, HP, Building Automation System (BAS) tag number and pressure settings based on actual system setup at time of commissioning.
- C. At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
- D. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.
- E. Provide labels for the following general categories of equipment and operational devices:
  1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  2. Meters, gages, thermometers and similar units.
- F. Equipment located concealed above ceilings or access doors shall be labeled utilizing an engraved tag or printed label, black 18-point size letters, on white background, mounted on the ceiling grid or on the access door.

### **3.4 CONFINED SPACE IDENTIFICATION:**

- A. Furnish and install confined space identification signs in a conspicuous location where approved by Owner's authorized representative for each permit required confined space. A permit required confined space is defined as a confined space in which an employee's whole body can enter, has an entrance into or exit from the space which is restricted in any way, and is not designed for continuous employee occupancy. In addition, a permit required confined space must have the potential to contain a hazardous atmosphere, contain a material such as fluid or particles that could trap or asphyxiate an entrant, or contain any other serious safety or health

hazard, such as an electrical or mechanical hazard. Examples of permit required confined spaces requiring signs are air handling units, boilers, cooling tower sumps, underground tanks, vaults or manholes, etc.

### **3.5 LABEL INSTALLATION**

- A. Pipe labels to be taped around pipe at both ends of label. Do not use plastic bands to hold on pipe markers.
- B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Locate labels near points where pipes enter into and exit from concealed spaces (fixed ceiling, shaft, underground, or similar concealment) and at maximum intervals of 50 feet in each space where pipes are exposed or concealed by removable ceiling system. Reduce intervals to 25 feet in areas of congested piping and equipment. Label piping at both sides of wall or floor penetrations.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
  - 8. Main isolation valves located concealed above ceilings or access doors shall be labeled utilizing an engraved tag or printed label, black 18-point size letters, on white background, mounted on the ceiling grid or on the access door.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- D. Pipe Label Color Schedule:
  - 1. Fire Protection Water: White letters on a safety-red background.

### **3.6 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Colors:
    - a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
    - b. Flammable Fluids: Black letters on a safety-yellow background.
    - c. Combustible Fluids: White letters on a safety-brown background.
    - d. Potable and Other Water: White letters on a safety-green background.
    - e. Compressed Air: White letters on a safety-blue background.

### **3.7 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

**END OF SECTION 21 0553**



**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. Wall-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 WALL-TYPE FIRE-DEPARTMENT CONNECTION**

- A. Standard: UL 405.
- B. Type: Exposed, wall mount.
- 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 wall, with pipe threads.
- I. Number of Inlets: (1) 4" Storz.
- J. Sleeve: Brass.
- K. Sleeve Height: 18 inches.
- L. Escutcheon Plate Marking: Similar to "AUTO SPKR" or "STANDPIPE" or "STANDPIPE AND AUTO SPKR" indicating type of system within building.
- M. Finish, Including Sleeve: Rough brass or bronze.
- N. Outlet Size: NPS 4.

**2.2 KNOX BOX**

- A. Contractor to provide and install Knox Box. Coordinate location with local fire marshal.

## **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 yard-type fire-department connections in concrete slab support. Comply with requirements for concrete in Section 033000 "Cast-in-Place Concrete."
- B. Install minimum of two protective pipe bollards around each fire-department connection.
- C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

**END OF SECTION 21 1119**



**SECTION 21 1313  
WET-PIPE SPRINKLER SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Pipes, fittings, and specialties.
  - 2. Cover system for sprinkler piping.
  - 3. Specialty valves.
  - 4. Sprinklers.
  - 5. Alarm devices.
  - 6. Pressure gages.
- B. Related Requirements:
  - 1. Section 211119 "Fire Department Connections" for exposed-, flush-, and yard-type fire department connections.

**1.3 DEFINITIONS**

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Plumbing piping systems.
  - 2. Mechanical piping systems.
  - 3. Items penetrating finished ceiling include the following:
    - a. Lighting fixtures.
- B. Qualification Data: For qualified Installer and professional engineer.

C. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Field Test Reports:

1. 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."
2. Fire-hydrant flow test report.

F. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

## 1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

## 1.9 FIELD CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.
2. NFPA 13R.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
- D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.
  1. Sprinkler system design shall be approved by authorities having jurisdiction.
    - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
    - b. Sprinkler Occupancy Hazard Classifications:
      - 1) Automobile Parking Areas: Ordinary Hazard, Group 1.
      - 2) Building Service Areas: Ordinary Hazard, Group 1.
      - 3) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      - 4) General Storage Areas: Ordinary Hazard, Group 1.
      - 5) Laundries: Ordinary Hazard, Group 1.
      - 6) Libraries except Stack Areas: Light Hazard.
      - 7) Library Stack Areas: Ordinary Hazard, Group 2.
      - 8) Machine Shops: Ordinary Hazard, Group 2.
      - 9) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
      - 10) Office and Public Areas: Light Hazard.
      - 11) Plastics Processing Areas: Extra Hazard, Group 2.
      - 12) Residential Living Areas: Light Hazard.
      - 13) Restaurant Service Areas: Ordinary Hazard, Group 1.
  2. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Residential (Dwelling) Occupancy: 0.05 gpm over 400-sq. ft. area.
    - b. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - d. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - e. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
    - f. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
    - g. Special Occupancy Hazard: As determined by authorities having jurisdiction.
  3. Maximum Protection Area per Sprinkler: According to UL listing.
  4. Maximum Protection Area per Sprinkler:
    - a. Residential Areas: 400 sq. ft.
    - b. Office Spaces: 225 sq. ft.
    - c. Storage Areas: 130 sq. ft.
    - d. Mechanical Equipment Rooms: 130 sq. ft..
    - e. Electrical Equipment Rooms: 130 sq. ft..
    - f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

## 2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40, Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M; or ASME B36.10M wrought steel. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, steel pipe with threaded ends.
- D. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.

- E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
    - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
  - 1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Pressure Rating: 175-psig minimum.
  - 2. 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.
  - 3. 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.
- K. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

### 2.3 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18 pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22 pressure fittings.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Copper Pressure-Seal Fittings:
  - 1. Standard: UL 213.
  - 2. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
  - 3. NPS 2-1/2 to NPS 4: Cast-bronze fitting with EPDM-rubber O-ring seal in each end.
- H. Grooved-Joint, Copper-Tube Appurtenances:
  - 1. Grooved-End Copper Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
  - 2. Grooved-End-Tube Couplings: To fit copper-tube dimensions, with design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gasket suitable for hot and cold water, and bolts and nuts.

### 2.4 CPVC PIPE AND FITTINGS

- A. CPVC Pipe: ASTM F 442/F 442M and UL 1821, SDR 13.5, for 175-psig rated pressure at 150 deg F, with plain ends. Include "LISTED" and "CPVC SPRINKLER PIPE" markings.
- B. CPVC Fittings: UL listed, for 175-psig rated pressure at 150 deg F, socket type. Include "LISTED" and "CPVC SPRINKLER FITTING" markings.
  - 1. NPS 3/4 to NPS 1-1/2: ASTM F 438 and UL 1821, Schedule 40, socket type.
  - 2. NPS 2 to NPS 3: ASTM F 439 and UL 1821, Schedule 80, socket type.
  - 3. CPVC-to-Metal Transition Fittings: CPVC, one piece, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
  - 4. CPVC-to-Metal Transition Unions: CPVC, with dimensions equivalent to pipe; one end with threaded brass insert, and one socket end.
  - 5. Flanges: CPVC, one or two pieces.

- C. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493 solvent cement recommended by pipe and fitting manufacturer and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
- D. Plastic Pipe-Flange Gasket and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.5 COVER SYSTEM FOR SPRINKLER PIPING

- A. Description: System of support brackets and covers made to protect sprinkler piping.
- B. Brackets: Glass-reinforced nylon.

## 2.6 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
  - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
  - 2. High-Pressure Piping Specialty Valves: 250-psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. Alarm Valves:
  - 1. Standard: UL 193.
  - 2. Design: For horizontal or vertical installation.
  - 3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
  - 4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
  - 5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
  - 6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Automatic (Ball Drip) Drain Valves:
  - 1. Standard: UL 1726.
  - 2. Pressure Rating: 175-psig minimum.
  - 3. Type: Automatic draining, ball check.
  - 4. Size: NPS 3/4.
  - 5. End Connections: Threaded.

## 2.7 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
  - 1. Standard: UL 213.
  - 2. Pressure Rating: 175-psig minimum.
  - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
  - 4. Type: Mechanical-tee and -cross fittings.
  - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
  - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
  - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
  - 1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  - 2. Pressure Rating: 175-psig minimum.
  - 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
  - 4. Size: Same as connected piping.

5. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
  1. Standard: UL 199.
  2. Pressure Rating: 175 psig.
  3. Body Material: Brass.
  4. Size: Same as connected piping.
  5. Inlet: Threaded.
  6. Drain Outlet: Threaded and capped.
  7. Branch Outlet: Threaded, for sprinkler.
- D. Sprinkler Inspector's Test Fittings:
  1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
  2. Pressure Rating: 175-psig minimum.
  3. Body Material: Cast- or ductile-iron housing with sight glass.
  4. Size: Same as connected piping.
  5. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
  1. Standard: UL 1474.
  2. Pressure Rating: 250-psig minimum.
  3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
  4. Size: Same as connected piping.
  5. Length: Adjustable.
  6. Inlet and Outlet: Threaded.
- F. Flexible Sprinkler Hose Fittings:
  1. Standard: UL 1474.
  2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
  3. Pressure Rating: 175-psig minimum.
  4. Size: Same as connected piping, for sprinkler.

## 2.8 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- D. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.
- E. Automatic Sprinklers with Heat-Responsive Element:
  1. Early-Suppression, Fast-Response Applications: UL 1767.
  2. Nonresidential Applications: UL 199.
  3. Residential Applications: UL 1626.
  4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- F. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
  1. Nominal Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
  2. Nominal Orifice: 17/32 inch with discharge coefficient K between 7.4 and 8.2.
- G. Sprinkler Finishes: painted.
- H. Special Coatings: Corrosion-resistant paint.
- I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
  1. Ceiling Mounting: Plastic, white finish, one piece, flat.
  2. Sidewall Mounting: Plastic, white finish, one piece, flat.
- J. Sprinkler Guards:
  1. Standard: UL 199.

2. Type: Wire cage with fastening device for attaching to sprinkler.

## **2.9 ALARM DEVICES**

- A. Alarm-device types shall match piping and equipment connections.
- B. 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.
- C. 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.
- D. 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.

## **2.10 PRESSURE GAGES**

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter. Provide isolation valve (ball) at pressure gage.
- C. Pressure Gage Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

### **3.2 SERVICE-ENTRANCE PIPING**

- A. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221120 "Plumbing Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in plumbing (Div 22) specifications.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

### 3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
  - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- F. Install sprinkler piping with drains for complete system drainage.
- G. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- H. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- I. Install alarm devices in piping systems.
- J. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- K. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- L. Fill sprinkler system piping with water.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

### 3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.



- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.
- Q. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.
- R. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

### **3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING**

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 or NFPA 13R for supports.

### **3.7 VALVE AND SPECIALTIES INSTALLATION**

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

- D. Specialty Valves:
  - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
  - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
  - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

### **3.8 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

### **3.9 IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.10 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Energize circuits to electrical equipment and devices.
  - 5. Coordinate with fire-alarm tests. Operate as required.
  - 6. Coordinate with fire-pump tests. Operate as required.
  - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.11 CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### **3.12 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

### 3.13 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. CPVC pipe, Schedule 40 or 80 CPVC fittings, and solvent-cemented joints may be used for light-hazard and residential occupancies.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 3 and smaller, shall be one of the following:
  - 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  - 2. Schedule 40, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
  - 3. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  - 4. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.
  - 5. Type L, hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.
  - 6. Type L, hard copper tube with plain ends; copper pressure-seal fittings; and pressure-sealed joints.
  - 7. NPS 3, Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.
- F. Standard-pressure, wet-pipe sprinkler system, NPS 4 and larger, shall be one of 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; welding fittings; and welded joints.
  - 3. Type L, hard copper tube with plain ends; cast- or wrought-copper, solder-joint fittings; and brazed joints.
  - 4. Type L, hard copper tube with roll-grooved ends; copper, grooved-end fittings; grooved-end-tube couplings; and grooved joints.

### 3.14 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
  - 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: Pendent, dry sprinklers and sidewall, dry sprinklers as indicated.
  - 5. Special Applications: Extended-coverage and quick-response sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
  - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
  - 2. Flush Sprinklers: White sprinkler with painted white escutcheon.
  - 3. Recessed Sprinklers: White sprinklers with painted white escutcheon. Residential Sprinklers: White sprinklers with painted white escutcheon.
  - 4. Pendent and Sidewall Sprinklers: White in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view.

**END OF SECTION 21 1313**



**SECTION 22 0500  
COMMON WORK RESULTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 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. Plumbing demolition.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.
  - 12. Pipe trenching and backfill.

**1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 22 shall be defined as the subcontractor who is responsible for the work specified or indicated. All subcontracted work must be incorporated by and coordinated by the prime contractor.
- F. 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.
- G. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- H. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

**1.4 DESCRIPTION OF WORK**

- A. Extent of plumbing related work required by this section is indicated on drawings and/or specified in other Division 22 sections.

- B. Except as noted in this specification, this Contractor shall do all excavating and backfilling necessary to the work of this Division.
- C. See specification Division 9 for painting requirements. Coordinate all mechanical painting work required. Coordinate protection requirements for mechanical equipment which could be damaged by paint.
- D. Furnish and install all miscellaneous steel required for supports, hangers, anchors, guides, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a moist environment shall be hot dipped galvanized unless otherwise noted.
- E. This Contractor shall furnish and install concrete foundations or bases under all equipment that rests on floors in Mechanical Equipment Rooms. Follow drawings and/or manufacturer's literature with regard to design and construction of same.
- F. This Contractor shall perform all Division 22 related and indicated selective demolition including nondestructive removal of materials and equipment for re-use or salvage as indicated. Unless otherwise indicated, dismantle mechanical materials and equipment made obsolete by these installations. All equipment removed shall be offered to the Owner for his retention. If the Owner elects to retain equipment, it shall be turned over to the Owner at the site. If not, the equipment shall be removed from the premises by this Contractor.
- G. Furnish and install sound stopping around penetrations or mechanical materials and equipment.
- H. Furnish and install fire and smoke penetration seals around penetrations of mechanical materials and equipment through fire or smoke barriers, floors and foundation walls.

#### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Mechanical System Penetration Seals: Submit the following:
  - 1. Shop drawings showing each condition requiring penetration seals in dictating proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.
  - 2. A copy of UL illustration of each proposed system indicating manufacturer approved modifications.
  - 3. Manufacturer's specifications, recommendations, installation instructions and maintenance instructions.
- C. Welding certificates

#### 1.6 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 Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

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

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## **1.8 MECHANICAL COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. This Contractor shall familiarize himself with the work to be done under other Divisions of this specification and their related drawings and shall so coordinate and schedule his work as not to cause delays or interference with the work of others. Such coordination and scheduling shall accomplish the installation of equipment and piping with a minimum of cutting through masonry and other adjustments.
- E. Ceiling grid systems shall not be supported from plumbing lines or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure-concrete, steel or masonry. Where interferences occur, in order to support piping, ceiling grid systems, etc., trapeze type hangers or supports shall be employed which shall be located so as not to interfere with access to such mechanical equipment as valves, regulators, VAV or reheat terminals, fire dampers, etc.
- F. This Contractor shall be responsible for proper size and location of anchors, chases, recesses, openings, etc., required for the proper installation of his work. Verify all dimensions by field measurements. Coordinate the installation of required supporting devices and sleeves in structural components as they are constructed. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.
- G. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. Extend all grease fittings to an accessible location. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with a minimum of interference with other installations.
- H. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- I. Specific divisions of responsibility when coordinating with trades other than mechanical shall be as indicated on drawings, in Division 01, and as follows:
  - 1. The indicated Contractor under this division shall run the indicated utilities outside the building to points as noted on the drawings. He shall be responsible for the actual tie-in to street utility services where routing to site utility services on drawings pertaining to this Division are indicated.
  - 2. Each Contractor under this division shall provide and place all sleeves in floors, walls, etc., and coordinate such location.
  - 3. Each Contractor under this division shall be responsible for flashing at vent roof terminals.
  - 4. Each Contractor under this division shall rough-in and connect all fixtures or equipment furnished by other trades or Owner where shown on the drawings.

5. Each Contractor under this division shall provide motors, special controls, transformers and relays as required for the proper operation of all equipment furnished by him under this Division.
6. The Contractors under this Division shall coordinate the location of floor drains and cleanouts with architectural and structural elements or work of other trades affecting the location of floor drains and cleanouts. Where floor drains are installed to serve specific pieces of equipment, coordinate the location of floor drains with the contractor who is providing the equipment, using manufacturer's shop drawings for the equipment served or written instructions from the equipment manufacturer.

#### **1.9 EXAMINATION OF SITE**

- A. Before submitting a bid, each Contractor is requested to visit the job site to familiarize himself with construction conditions. No consideration or remuneration will be given for his failure to do so.

#### **1.10 DIVISION 22 DESIGN DOCUMENTS**

- A. Should it appear that there is a duplication on the drawings or in the specifications, wherein the same work or items are shown or specified as being provided under separate subcontracts or supply orders, and such duplication is not clarified by addendum during the bidding period, it shall be assumed that the responsible prime contractor will select and coordinate which subcontract will supply the item and the item will be supplied as indicated. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on mechanical plans and Division 22 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all applicable mechanical work in his bid.
- B. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment and piping unless dimensions are given. Drawings are not to be scaled.
  1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instructions.
    - a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.
    - b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.
  2. Piping is to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional offset and fittings shall be provided as necessary to meet space constraints and to facilitate the work of other trades.
    - a. Recognizing the potential need for additional offsets and fittings in piping, the Engineer has included a safety factor in all friction calculations. The Contractor is advised to plan and coordinate his work carefully to minimize the need for additional offsets and fittings. The Contractor shall be responsible to notify the Engineer of any and all modifications to systems which may affect the ability of equipment to serve its intended use prior to the purchase and installation of such equipment.



- C. All equipment, piping and material specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.
- D. If this Contractor proposes to install equipment requiring space conditions other than those as specified and/or shown on the design drawings, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall obtain the full approval of the Design Professional before proceeding with the work.

#### **1.11 RECORD DOCUMENTS**

- A. Prepare record documents in accordance with the requirements of this division, and in Division 01.
- B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of prints. Changes shall be accurately dimensioned and/or drawn to scale.
- C. This Contractor shall keep an updated set of specifications and prints, including changes on the job site, at all times and shall submit one (1) set of updated and legible prints to the Design Professional when the work is complete.

#### **1.12 COORDINATION DRAWINGS**

- A. Before construction work commences, Contractors for all trades shall submit coordination drawings in AutoCad drawn to scale for review. Such drawings will be required throughout all areas for all trades. The requirements for Coordination Drawings are specified in Division 23 and are reprinted below:
  - 1. The HVAC Contractor shall prepare the base plan coordination drawings showing all ductwork, all pertinent heating piping and equipment. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearances, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Architect and Engineer. Provide adjustments to exact size, location and offsets of ducts, pipes, conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.
  - 2. HVAC Contractor shall provide the base plan in AutoCad and submit the base plan to all major trades' Contractors. All ductwork and piping shall be on separate layers.
  - 3. The Fire Protection Contractor shall draft location of piping, sprinkler heads and equipment on the base plan using a separate layer, indicating areas of conflict and suggested resolutions.
  - 4. The Plumbing Contractor shall draft location of all piping and equipment on the base plan using a separate layer.
  - 5. The Electrical Contractor shall draft location of lighting fixtures, cable trays, and feeders over 2 in. on the base plan using a separate layer, indicating areas of conflict and suggested resolution.
  - 6. The HVAC Contractor shall then combine all layers on a composite AutoCad drawing indicating all areas of conflict.
  - 7. The General Trades Contractor shall indicate areas of architectural/structural conflicts or obstacles and coordinate to suit the overall construction schedule.
  - 8. The Construction Manager shall expedite all drawing work and coordinate to suit the overall construction schedule. He shall then review these drawings and compare them with the architectural, structural, equipment and other drawings and determine that all of the work can be installed without interference. In the case of unresolved interferences, he shall notify the Architect. The Architect will then direct the various Contractors as to how to revise their drawings as required to eliminate installation interferences.

9. If a given trade proceeds prior to resolving conflicts, then, if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given for individual areas after special site meetings involving all Trades.
10. Coordination drawings are intended for the respective Contractor's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.
11. After resolution of all conflicts, all trades shall sign and date a hard copy of the composite coordination drawing.

### **1.13 SHOP DRAWINGS**

- A. Refer to the conditions of the Contract (General and Supplementary) and Division 01 Section: Shop drawings, product data, and samples for submittal definitions, requirements, and procedures.
- B. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information required by the contract documents. Shop drawings not stamped with Contractor approval will be returned for reprocessing.
  1. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.
  2. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.
  3. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.
  4. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.
- C. In checking shop drawings, the Design Professional will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.
- D. Submit two three four five six (ENGINEER TO FILL IN #) prints each of shop drawings to the Design Professional. The prints shall contain a blank 6" x 3" area for Engineer's stamp. Shop drawings which do not contain a blank space for Engineer's approval stamp will be returned for reprocessing. The Architect and Engineer shall each retain one (1) print and return the remainder to the Contractor who shall print and distribute copies as required to properly conduct the work; including requirements of the operating manual.

### **1.14 EQUIPMENT**

- A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that the manufacturer of all parts of the equipment offered has been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.
- B. When two or more items of same equipment are required (plumbing fixtures, pumps, valves, etc.) they shall be of the same manufacturer.
- C. In placing his bid, the Contractors under this Division shall take note that manufacturer's products change frequently, and only the scheduled products have been checked by the

Engineer for compliance with the Contract Documents and physical characteristics. Other manufacturers are listed because they are believed to be capable of complying and in order to achieve fair and competitive bidding. However, it is the responsibility of the manufacturer in his relationship with the Contractor to bid to the Contractor only products complying with the Contract Documents, and the responsibility of the Contractor to base his bid only on manufacturers which do comply. No consideration will be given to the Contractor for his failure to do this. Should Contractors during the bidding process discover that listed manufacturers cannot comply with the Documents, they are encouraged to contact the Engineer as soon as practical, and provided sufficient time in the bidding process exists, and the Engineer agrees with the request, the Engineer will attempt to adjust the documents in the addendum process. If no addendum is issued adjusting the requirements so that all listed manufacturers can bid, the Contractor will be required to supply one of the listed manufacturers which comply with the Contract Document requirements.

#### **1.15 SUBSTITUTIONS**

- A. Refer to the Instructions to Bidders and the related Division 01 sections for requirements in selecting products and requesting substitutions.
- B. Bids concerning the use of substitute products must be accompanied by complete specifications and performance characteristics covering these products, together with such available test data and experience records as may be helpful to the Design Professional in evaluating the quality and/or suitability of the proposed products.
- C. The intent of this paragraph is to make the specifications open to all available makes of material and apparatus during the bidding period. Certain definite makes or kinds of items are specified as "standards of quality" and character required. Each Contractor is required to bid upon the basis of furnishing the makes specified. He is also invited to bid on any other similar makes he (the Contractor) may desire to propose as substitutions, stating any difference in cost for each proposed substitution on the Substitution Sheet, if there is a difference. If the Design Professional shall decide to accept any of the proposed substitutions, proper notations thereof shall be made in the written contract. Where several makes are mentioned in the specifications and the Contractor fails to state that he prefers a particular make in his bid, the Owner shall have the right to choose any of the makes mentioned without change in price. No consideration will be given to proposals for alternative products unless submitted with the original bids.

#### **1.16 SUPERVISION**

- A. The Contractor shall have in charge of work at all times during construction a competent foreman or superintendent whose experience and background shall qualify him for the work to be performed under this division. Once assigned, the foreman or superintendent shall be retained until completion of the project and any consideration as to his removal on grounds of incompetence shall either be initiated by or referred to the Design Professional for decision.

#### **1.17 CODES AND PERMITS**

- A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.
- B. Install work in full accordance with rules and regulations of the State of Ohio, Summit County and the City of Akron authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Compliance. Do not construe this as relieving Contractor from compliance with any requirements of specifications which are in excess of Code requirements and not in conflict therewith. Sanitary waste and vent piping indicated may, in some instances, exceed code

requirements. If drawings indicate individual wastes for each fixture, the drawings shall hold precedent over the Code as long as pipe sizing equals or exceeds prescribed waste and vent Code minimums.

- C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for work performed by them in connection with provision of service connections required under this DIVISION of specifications. Deliver all certificates to Design Professional in duplicate.

#### **1.18 INTERFERENCES**

- A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Design Professional may direct to permit completion of Architectural work in accordance with plans and specifications.
- B. Install additional offsets on piping where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- C. Report any interferences between work under this division and that of any other Contractors to the Design Professional as soon as they are discovered. The Design Professional will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

#### **1.19 SHOP AREAS AND MATERIAL STORAGE**

- A. No mechanical related trade is permitted to use as shop working area, any concrete slab that is to receive metallic waterproofing, asphalt tile, plastic tile, etc., except by expressed permission of the Design Professional.
- B. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

#### **1.20 CLEAN-UP**

- A. Refer to the Division 01 for general requirements for project cleaning.
- B. Insofar as the Mechanical work is concerned, at all times keep premises and building in neat and orderly condition follow explicitly any instructions of Design Professional in regard to storing of materials, protective measures, cleaning-up of debris, etc.
- C. Upon completion of work this Contractor shall thoroughly clean all apparatus furnished by him, pack all valves and thoroughly clean piping, fixtures, and equipment removing all dirt, grease and oil.

#### **1.21 OPERATING AND MAINTENANCE**

- A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 22 specification sections in the proper operation of the mechanical equipment. He shall also supply the Owner with three (3) hardbound copies of an operation manual containing the following:
  - 1. Step-by-step procedures for start-up and shutdown for each system and piece of equipment.
  - 2. Performance data, curves, ratings.
  - 3. Wiring diagrams.

4. Manufacturer's descriptive literature.
5. Automatic controls with diagrams and written sequence of operation.
6. Manufacturer's maintenance and service manuals.
7. Plumbing fixtures.
8. Spare parts and replacement parts list for each piece of equipment.
9. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
10. Final approved shop drawings.

#### **1.22 WARRANTIES**

- A. Refer to the Division 01: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.
- B. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Design Professional, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 22 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

#### **1.23 TEMPORARY SERVICES**

- A. The Contractor under this division shall provide temporary services, i.e.: water, fuel, sanitary, or storm as specified herein or in Division 01 portions of this specification.
- B. Permanent equipment may be used for temporary (construction period) services only as directed by the Design Professional. Any permanent equipment used, shall be maintained by this Contractor. Owner's warranty period shall not begin until final acceptance of the completed system.

#### **1.24 PROTECTION OF WORK AND PROPERTY**

- A. The Contractor shall be responsible for safeguarding work, property and facilities against damage, both his own as well as others, with which he may come into contact in the performance of his work.
- B. Stored materials shall be protected against damage from weather. Pipe shall be closed with caps or plugs during installation. All fixtures and equipment shall be covered and protected against injury. Any materials or equipment damaged at any stage in the construction shall be replaced or repaired, and at the final completion of all work shall be in a clean, unblemished condition.

#### **1.25 CUTTING AND PATCHING**

- A. Refer to the Division 01 for general requirements for cutting and patching.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- C. Each contractor under this division shall perform cutting, fitting, and patching of building components and mechanical equipment and materials required to:
  1. Uncover Work to provide for installation of ill-timed Work;
  2. Remove and replace defective Work;
  3. Remove and replace Work not conforming to requirements of the Contract Documents;
  4. Remove samples of installed Work as specified for testing;

- 5. Install equipment and materials in existing structures;
- 6. Upon written instructions from the Design Professional, uncover and restore Work to provide for Design Professional observation of concealed Work.
- 7. Install new work.
- D. See other sections of this specification for demolition requirements.
- E. Pipe holes in floors and walls shall be core drilled if not sleeved during construction.

## 1.26 INTERRUPTION OF SERVICE

- A. When work progress makes temporary shutdown of services unavoidable, shutdown shall be coordinated with and approved by Owner so as to cause minimum disruption to established operating routine. Arrange to work as necessary to re-establish service within shortest possible down time. In those instances where the length of time required for the service interruption is not acceptable to the Owner, unless otherwise indicated, furnish and install temporary connections as required to reduce the length of time of service interruption to an acceptable level.

## 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 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 EXCAVATING FOR DIVISION 22 WORK

- A. Backfill Materials:
  - 1. All backfilling within the building shall consist of an initial 12" layer of sand over the pipe. The remainder of the backfill shall be course interlocking aggregate or limestone screenings.
  - 2. All backfilling outside the building shall be selected dirt, free of large stones.

### 2.4 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.  
Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.  
Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.5 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 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:

- a. Perfection Corp.
- b. Precision Plumbing Products, Inc.
- c. Sioux Chief Manufacturing Co., Inc.
- d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless Steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

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

## 2.8 ESCUTCHEONS

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

## 2.9 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.

## **2.10 DESIGN AND PROPORTIONING OF CONCRETE MIXES**

- A. General: Design mechanical work concrete as follows, for each 28-day compressive strength class:
  1. 3000 psi Class: 500 lbs of cement per cu. yd. (5.25 sacks), and 0.46 water/cement ratio.
  2. 2500 psi Class: 450 lbs. of cement per cu. yd. (4.75 sacks), and 0.54 water/cement ratio.
  3. Rough Grouting Class: 565 lbs. of cement per cu. yd. (6.0 sacks), and 0.60 water/cement ratio.
- B. Mix for Patching: Where mechanical work requires patching of exposed concrete work which has been cut to accommodate mechanical work, provide concrete patching mix which is identical with mix of work being patched (same cement, aggregates, admixtures and proportioning).

## **PART 3 - EXECUTION**

### **3.1 PLUMBING DEMOLITION**

- A. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
  1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
  3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
  5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.2 PROJECT CONDITIONS, EXCAVATION AND BACKFILL FOR DIV. 22 WORK**

- A. Site Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor. Failure to adjust for subsurface conditions indicated shall not warrant cause for additional compensation.
- B. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- C. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during excavation operations.
- D. Notify proper authorities prior to commencing excavation. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in

- keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
- E. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, during occupied hours, except when permitted in writing by Architect/Engineer and then only after acceptable temporary utility services have been provided.
    - 1. Provide minimum of 48-hour notice to Architect/Engineer, and receive written notice to proceed before interrupting any utility.
  - F. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active.
  - G. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Where trenches cross roads, walks, or public thoroughfares, provide suitable barricades and bridges adequately protected by signs or red flags during day and lights at night.
  - H. Operate warning lights as recommended by authorities having jurisdiction.
  - I. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.
    - 1. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.
  - J. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install mechanical work on frozen excavation bases or subbases.
  - K. General: Do not excavate for mechanical work until work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum.
  - L. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
  - M. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
  - N. Deep Excavation Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
  - O. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
  - P. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.
  - Q. Dewatering: Lay no pipe in water. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - R. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to stability of subgrades. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
  - S. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
  - T. Excavation for Pavements: Cut surface under pavements as required. Repave all streets or sidewalks disturbed at this Contractor's expense, to recommendations, procedures and satisfaction of the Architect/Engineer and authorities having jurisdiction.
  - U. Excavation for Trenches: Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 6" to 9" clearance on both sides of pipe.
  - V. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations. Beyond building perimeter, keep

- bottoms of trenches sufficiently below finished grade to avoid freeze-ups. Any trenches dug below required depth shall be filled to proper depth with sand.
- W. Where rock is encountered, carry excavation 6" below required elevation and backfill with a 6" layer of crushed stone or gravel prior to installation of pipe.
  - X. For pipes 5" or less in nominal size, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
  - Y. For pipes or conduit 6" or larger in nominal size, tanks and other mechanical work indicated to receive subbase, excavate to subbase depth indicated, or, if not otherwise indicated, to 6" below bottom of work to be supported.
  - Z. Except as otherwise indicated, excavate for exterior water-bearing piping (water, steam, condensate, drainage) so top of piping is not less than 3'-6" below finished grade.
  - AA. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
  - BB. Backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of bottom of adjacent footing.
  - CC. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.
  - DD. For piping or conduit less than 2'-6" below surface of roadways, provide 4" thick concrete base slab support. After installation and testing of piping or conduit, provide minimum 4" thick encasement (sides and top) of concrete prior to backfilling or placement of roadway subbase.

### **3.3 PREPARATION OF FOUNDATION FOR BURIED PIPING**

- A. Grade trench bottom to provide smooth, firm, stable, and rock-free foundation throughout length of piping.
- B. Remove unstable, soft, and unsuitable materials at surface on which piping is to be laid, and backfill with clean material as specified.
- C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped-sand backfill. Dig bell holes at each pipe joint to relieve bells of loads and to ensure continuous bearing of pipe barrel on foundation.
- D. Care shall be exercised to keep interior of buried piping free of dirt and foreign matter.
- E. Where trenching for pipe is excessively wide, the contractor shall, at his own expense, embed the pipe in concrete to support the added load of backfilling.

### **3.4 BACKFILLING**

- A. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.
- B. Install drainage fill where indicated, and tamp to uniform firm density.
- C. Backfill with finely-graded subbase material to 6" above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.
- D. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to required densities. Do not backfill with frozen soil materials.
- E. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously; do not dislocate work from installed positions.
- F. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (% of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.
  - 1. Lawn and Landscaped Areas: 85% of cohesive soils; 90% for cohesionless soils.

- 2. Paved Areas, Other Than Road ways: 90% for cohesive soils; 95% for cohesionless soils.
- 3. Roadways: 90% for cohesive soils; 95% for cohesionless soils.
- G. Backfill to elevations matching adjacent grades, at time of backfilling excavations for mechanical work.

### 3.5 DISPOSAL OF EXCESS AND WASTE EXCAVATION MATERIALS

- A. Removal from Owner's Property: Remove excess excavated material, trash, debris and waste materials and dispose of it off Owner's property.

### 3.6 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping 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 according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.

- b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
  - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
  - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
  - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
  - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
  - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
  - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- P. 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.

- Q. 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 (25-mm) 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.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.7 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

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

### **3.8 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.
    - a. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
    - b. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.9 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.10 PAINTING**

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

### **3.11 SURFACE PREPARATION FOR PAINTING**

- A. General: Clean surfaces before applying paint products. Remove oil and grease prior to mechanical cleaning. Comply with paint products manufacturer's instructions for surface cleaning and preparation. Remove surface-applied accessories which are not to be painted, and reinstall after completion of painting. Protect non-removable items not to be painted, by covering with paper or plastic film.
- B. Ferrous Metal Surfaces: Clean and remove mill scale and loose rust on surfaces which are not zinc-coated or shop/factory prime coated.
- C. Zinc-Coated Surfaces: Clean with non-petroleum based solvent. Wash with copper sulfate solution and flush with water, unless surface has been pretreated, or unless treatment is not recommended by manufacturer of prime coat.

### **3.12 PAINT SYSTEM APPLICATION**

- A. Environmental Conditions, Painting Work: Comply with governing regulations concerning use of and conditions for application of paint. Comply with manufacturer's recommendations and instructions. Do not apply paint in unfavorable conditions of temperature, moisture (including humidity) or ambient contamination (dust and other pollutants).

- B. Mixing: Comply with manufacturer's recommendations for mixing or stirring paint products immediately before application.
- C. Application Limitations: Except as otherwise indicated, paint every accessible surface of each unit of work indicated to be painted, regardless of whether in location recognized as "concealed" or "exposed".
  - 1. Omit painting on surfaces located in service shafts and above non-removable ceilings and in similar places where in the opinion of the Engineer, space is too limited or services are too congested to allow access for painting.
  - 2. Omit painting on machined sliding surfaces and rotating shafts of equipment, and on nonferrous finished metals including chrome plate, stainless steel, special anodized aluminum, brass/bronze and copper, and on plastics and similar finished materials, except where specifically indicated to be color-coded by painting.
  - 3. Omit painting on required name plates, labels, identification tags, signs, markers, printed instructions, performance ratings, flow diagrams and similar text and graphics, located within the scope of work indicated to receive paint application.
  - 4. Omit specified prime coat of paint system for metal surfaces where surface has shop-applied prime coat of equivalent quality. Apply prime coat on other surfaces to be painted; comply with paint manufacturer's instructions for prime coating where not otherwise indicated. Apply additional prime coats where suction spots or unsealed areas appear.
- D. General Application Requirements: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate, for type of material being applied, and for ambient conditions. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Apply paint at edges, corners, joints, welds and exposed fasteners in manner which will ensure dry-film thickness equal to that of flat surfaces. Allow sufficient time between successive coats for proper drying (comply with manufacturer's drying instructions).
  - 1. Number of Coats: Number indicated is minimum number; apply as many coats as are necessary to comply with dry-film thickness requirements.
  - 2. Coating Thickness: Apply uniform coats to produce dry-film thickness indicated or, if not otherwise indicated, apply paint without thinning in application thickness recommended by manufacturer for each coat.
  - 3. Smooth Finishes: Except as otherwise indicated, apply paint in smooth finish without noticeable texture, cloudiness, spotting, holidays, laps, brush marks, runs, sags, ripples, ropiness and other surface imperfections.
  - 4. Textured Finishes: Where indicated, roll and redistribute paint of final coat to even texture. Match adjoining texture paint finishes if any, and roll to eliminate evidence of roller or lap marks and other unevenness and imperfections.

### 3.13 PAINTING CLEAN-UP AND PROTECTION

- A. General Painting Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. When directed by Architect/Engineer, retain paint containers from application of coatings on particular unit or area of work, until average dry-film thickness has been calculated.
  - 1. Spattered Surfaces: Upon completion of painting work, clean paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
  - 2. Protection: Protect work of other trades, whether to be painted or not, against damage by painting work. Correct damage by cleaning, repairing or replacing and repainting as directed. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings installed for protection of work not to be painted, after completion of painting operations. At



completion of work by other trades, touch-up and restore damaged or defaced painted surfaces.

### 3.14 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

### 3.15 INSTALLATION OF CONCRETE WORK

- A. Formwork:
  - 1. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be required size and shape and in required location. Construct with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.
    - a. Install chamfer strips at external corners of exposed concrete work.
    - b. Construct forms to retain equipment anchor bolts in accurate locations during placement of reinforcing steel and concrete. Use templates furnished by equipment manufacturers to locate anchor bolts or, where not furnished, locate by accurate measure from certified setting diagrams.
- B. Placing Reinforcement:
  - 1. General: Comply with requirements and recommendations of specified standards, including "Placing Reinforcing Bars" by CRSI. Place bars where indicated and support to prevent displacement during concrete placement, using appropriate reinforcement supports, properly spaced and wire tied to reinforcing bars.
    - a. Place reinforcement to obtain at least minimum recommended coverages for concrete protection. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
  - 2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which would reduce bond with concrete.
- C. Placing Concrete:
  - 1. Wet wooden forms which have been coated with compound, immediately before concrete, and remove excess water from forms.
  - 2. Strength-Class Application: Comply with the following general application requirements.
    - a. Backfill: Provide backfill class (lean concrete).
    - b. Underground Structural Concrete: Provide 3000 PSI class.
    - c. Block-Type Foundations: Where least dimension is not less than 0.2 x largest dimension, provide 3000 PSI class.
    - d. Beam-Type Foundations: Where least dimension is less than 0.2 x largest dimension, provide 4000 PSI class.
    - e. Miscellaneous Supported Work: Provide 3000 PSI class for curbs, pads, and similar supported work.
    - f. Concrete Fill: Provide 2500 PSI class for filling structural steel foundation frames and for filling similar large-volume units.
    - g. Concrete Grout: Provide rough grouting class for filling voids to be grouted which are too small to be filled effectively with 2500 PSI class concrete.
    - h. Patching General Concrete Work: Match concrete being patched.
  - 3. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause

formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.

4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
  5. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 deg F, heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 deg F, and not more than 80 deg F, at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.
  6. Finishing Horizontal Surfaces: Float and trowel horizontal (top) surfaces to level, smooth, uniform textured, dense finish, where surface is to remain exposed or receive coating, membrane or other thin-set finish. Otherwise, leave struck-off surface undisturbed; except scratch surfaces which are to receive concrete or mortar topping or setting bed, by raking with a stiff broom.
  7. Depress top of concrete backfill sufficiently so that supported work can be set in bed of mortar or sand as indicated.
  8. Curbs: Provide monolithic finish on interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to hard, dense finish with corners, intersections and terminations slightly rounded and coved.
  9. Surface Repairs:
    - a. Unexposed Surfaces: Repair significantly damaged and honeycombed areas, and remove major projections and fins where forms have been removed.
    - b. Exposed Surfaces: On formed surfaces which are to be exposed, including those to be coated or covered with membrane or other thin-set applied finish, repair and patch form-tie holes and damaged and honeycombed areas, filling voids with grout and completely removing fins and other projections.
- D. Concrete Curing and Protection:
1. General: Protect freshly placed concrete from drying and excessively cold and hot temperatures, and maintain in moist condition at relatively constant temperature for period of time necessary for hydration of cement, proper hardening, and achievement of strength requirements as specified.
- E. Miscellaneous Concrete Work:
1. Concrete Grouting: Space approximately 1" thick between bottom of equipment and top of concrete foundation or base which remains after shimming, shall be filled completely with grouting. Grout shall be made up with sand and cement designed for the purpose which does not shrink on setting up. Exposed surface of grouting shall be finished to make a neat appearance. Grout openings and recesses as indicated, in and around mechanical work and other work which penetrates or adjoins mechanical concrete work, using rough grouting class of concrete mix. Provide formwork where required, and tamp, screed and trowel surfaces. Cure grout as specified for concrete work.
  2. Concrete Bases: In the absence of more specific information, either on drawings, or manufacturer's literature, the bases shall be level, shall have a minimum height above finished floor of 4" and extend 3" beyond the skids, feet or bed plate of the item of equipment.

3. Concrete pads, beams, pedestals, or saddles placed in existing structures shall be mounted securely to the original substrate with anchor bolts.
- F. General Concrete Clean-Up: Upon completion of concrete work, clean excess concrete from adjacent areas and surfaces. Remove excess concrete by proper methods of washing or scraping, using care not to scratch or otherwise damage finished surfaces.

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

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

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

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

### **3.18 GROUTING**

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

### **3.19 SELECTIVE DEMOLITION**

- A. General: demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- B. Protect adjacent materials indicated to remain.
- C. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
- D. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- E. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for relocation or storage.
- F. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- G. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
  1. Inactive and obsolete piping, supports, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.
    - a. Unless otherwise indicated, piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new

- installations. Remove materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
2. Perform cutting and patching required for demolition in accordance with requirements of other sections of this specification.
- H. The use of explosives in this work is prohibited.

### **3.20 MECHANICAL SYSTEM SOUND STOPPING**

- A. Where pipes or other components of Division 22 work pass through non-fire rated walls or floors, but walls which extend from horizontal structure to structure, provide sound stopping between such mechanical work and the building structure intended to reduce the transmission of sound from one side of the wall to the other.
- B. Sound stopping of pipes in sleeves shall consist of sealing the outside of the sleeve with caulking and the inside with an insulating material.
- C. Sound stopping of pipes or ducts without sleeves shall consist of packing the cavity around the penetration with an insulating material and sealing the opening with approved sealant or plaster.
- D. Insulating materials shall be non-asbestos and non-friable, and shall have a flame spread rating of no more than 25 and a smoke developed rating of no more than 50.

### **3.21 MECHANICAL SYSTEM PENETRATION SEALS**

- A. Where pipes or ducts or other components of Division 22 work pass through fire or smoke rated walls or floors, provide non-asbestos seal assemblies classified by UL to provide fire barriers equal to the time rating of the construction being penetrated, with materials that comply with applicable codes and that have been tested in accordance with UL 1479 or ASTM E-814.
- B. Install penetration seal materials in accordance with printed instructions of the UL Building Materials Directory and in accordance with manufacturer's instructions. Seal all holes or voids made by penetrations. Where floor openings without penetrating items are more than four inches in width and subject to traffic or loading, install fire stopping materials capable of supporting same loading as floor.

### **3.22 TESTS AND ADJUSTMENTS**

- A. Upon completion of the erection of all equipment and all work specified herein and/or shown on approved drawings, or at such times as directed by the Design Professional, this Contractor shall start all apparatus, make necessary tests as directed and as specified herein and make complete adjustments of all items of equipment before acceptance by the Design Professional to whose representative this Contractor shall demonstrate (by performance) all of the various apparatus and equipment.
- B. When the Contractor is ready to run capacity tests, he shall notify the Design Professional. When this notice is given, the Design Professional will assume that the Contractor has made preliminary tests and is satisfied that the plant will develop specified and guaranteed capacities. It will be the Contractor's responsibility to furnish any and all instruments required to obtain test data which shall include thermometers, electric meters, pressure gages, etc.
- C. Work under this division of the specifications shall not be considered complete until the Contractor has obtained required inspection, performance tests, made necessary adjustments and has submitted satisfactory evidence of compliance. The Design Professional or his representative will make spot checks to determine the accuracy and completeness of final adjustments. Should spot checks indicate more than a reasonable deviation from design requirements, the Contractor shall repeat tests and adjustments to the satisfaction of the Design Professional.

### **3.23 PUNCHLISTS**

- A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional.

**END OF SECTION 22 0500**

**SECTION 22 0513  
COMMON ELECTRICAL REQUIREMENTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

**1.2 SUMMARY**

- A. This section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings, and further described in other specification sections.

**1.3 SUBMITTALS**

- A. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections. Submit compliance to referenced standards and efficiencies.
- B. Free standing motors, starters, and other electrical components not submitted under other sections shall require separate submittal.
- C. Submit manufacturer's electrical requirements for power supply wiring. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

**1.4 QUALITY ASSURANCE**

- A. National Electrical Manufacturer's Association (NEMA) Standards MG 1: Motors and Generators, "Energy Efficient Design".
- B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standard 250: Enclosures for Electrical Equipment
- D. NEMA Standard KS 1: Enclosed Switches
- E. Comply with National Electrical Code (NFPA 70). Provide motors specified in this section that are "Listed and Labeled" as defined in Article 100.
- F. IEEE 841: Severe duty motors.

**PART 2 - PRODUCTS**

**2.1 MOTORS**

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
  - 1. Motors ½ HP and Larger: Polyphase.
  - 2. Motors Smaller than ½ HP: Single phase.
  - 3. Frequency Rating: 60 Hz.
  - 4. Voltage Rating: Determined by voltage of circuit to which motor is connected.
  - 5. Starting Capability: Frequency of starts as indicated by automatic control system, and not less than 5 evenly time spaced starts per hour for manually controlled motors.

6. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
7. Temperature Rise: Match insulation rating, unless otherwise indicated.
8. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence and without exceeding nameplate ratings or considering service factor.
9. Enclosure Type: Shall be open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, guarded drip-proof motors where exposed to contact by employees or building occupants, and weather protected Type I for outdoor use, Type II where not housed.
10. Overload Protection: Built-in thermal overload protection rated at 115% of full load motor and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
11. Noise Rating: Provide "Quiet" rating on motors located in or near occupied spaces of building.
12. Efficiency: Motors shall have a minimum efficiency as scheduled in accordance with NEMA Standard MG-1, most current table for high efficiency motors. Motors must meet or exceed the guaranteed minimum of this standard and shall be nameplated with the nominal value.

B. Polyphase Motors:

1. Description: NEMA MG 1, medium induction motor.
  - a. Design Characteristics: NEMA MG 1, Design B, unless otherwise indicated.
  - b. Energy-Efficient Design: Where indicated.
  - c. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
  - d. Rotor: Squirrel cage, unless otherwise indicated.
  - e. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
  - f. Temperature Rise: Match insulation rating, unless otherwise indicated.
  - g. Insulation: Class F, unless otherwise indicated.
2. Inverter Duty Motors Used with Variable-Frequency Drives: Ratings, characteristics, and features coordinated with and approved by drive manufacturer.
  - a. Critical vibration frequencies are not within operating range of drive output. Comply with NEMA MG1-1993, Part 31.40.4.2.
  - b. Temperature Rise: Match insulation rating.
  - c. Insulation: Class F.
3. Severe-Duty Motors: Where indicated, motors are totally enclosed with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings are insulated with nonhygroscopic material. External finish is chemical-resistant paint over corrosion-resistant primer.
4. Source Quality Control: Perform the following routine tests according to NEMA MG 1:
  - a. Measurement of winding resistance.
  - b. No-load readings of current and speed at rated voltage and frequency.
  - c. Locked rotor current at rated frequency.
  - d. High-potential test.
  - e. Alignment.

C. Single-Phase Motors:

1. Type: As indicated in equipment specification sections, or if not indicated as selected by manufacturer from one of the following, to suit starting torque and other requirements of specific motor application.
  - a. Permanent-split capacitor.

- b. Split-phase start, capacitor run.
    - c. Capacitor start, capacitor run.
  - 2. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 hp.
  - 3. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
  - 4. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.
- D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering motors that may be incorporated into the work include the following:
  - General Electric
  - Lincoln
  - Louis Allis
  - Marathon
  - Reliance Electric
  - U.S. Motors
  - Westinghouse

## 2.2 DISCONNECT SWITCHES

- A. Fusible Switches: Fused, each phase; general duty; horsepower rated; quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
- B. Non-fusible Switches: Shall be horsepower rated; toggle switch type; quantity of poles and voltage rating where specifically indicated.
- C. Except where item of mechanical equipment must be integrally furnished with disconnect switch produced by another manufacturer, provide disconnect switches for mechanical equipment manufactured by single one of the following:
  - Allen-Bradley
  - General Electric
  - ITE
  - Square "D"
  - Sylvania
  - Westinghouse

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install motors on motor mounting systems in accordance with motor manufacturer's instructions, securely anchored to resist torque, drive thrusts, and other external forces inherent in mechanical work. Secure sheaves and other drive units to motor shafts with keys and Allen set screws, except motors of 1/3 HP and less may be secured with Allen set screws on flat surface of shaft. Unless otherwise indicated, set motor shafts parallel with machine shafts. Align pulleys and shafts and set tension as applicable according to manufacturer's written instructions.
- B. Install power and control connections for motors to comply with NEC and applicable provisions of Division 26 sections. Install grounding except where non-grounded isolation of motor is indicated.

### 3.2 INSTALLATION OF ELECTRIC HEAT TRACING



- A. Apply the heater linearly on the pipe after piping has been successfully pressure tested. Secure the heater to piping with cable ties or fiberglass tape.
- B. Apply "electric traced" signs to the outside of the thermal insulation.
- C. Install and test/calibrate heat trace tape thermostat.
- D. After installation and before and after installing the thermal insulation, subject heat to testing using a 1000 VDC megger. Minimum insulation resistance should be 20 to 1000 megaohms regardless of length.
- E. Instruct Owner on proper operation of heat trace.

**END OF SECTION 23 0513**

**SECTION 22 0519**  
**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Thermometers.
  - 2. Gages.
  - 3. Test plugs.
- B. Related Sections:
  - 1. Division 22, Section "Common Work Results for Plumbing".

**1.3 DEFINITIONS**

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturing of piping and equipment specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
  - 1. ANSI and ISA Compliance: Comply with applicable portions of ANSI and the Instrument Society of American (ISA) standards pertaining to the construction and installation of meters and gages.

**1.5 SUBMITTALS**

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.
  - 1. Submit a meter and gage schedule showing manufacturer's figure number, scale range, locations and accessories for each meter and gage.

**PART 2 - PRODUCTS**

**2.1 GLASS THERMOMETERS**

- A. General: Provide liquid in glass thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Case: Die cast aluminum finished in baked epoxy enamel, clear acrylic plastic, spring secured, 9" long.
- C. Adjustable Joint: Die cast aluminum finished to match case, 180 deg adjustment in vertical plane, 360 deg adjustment in horizontal plane, with locking device.

- D. Tube and Capillary: Non-toxic, blue-reading organic filled, magnifying lens, 1% scale range accuracy, shock mounted.
- E. Scale: Satin faced, non-reflective aluminum, permanently etched markings.
- F. Stem: Copper-plated steel, or brass, for separable socket, length to suit installation.
- G. Range: Conform to the following:
  - 1. Domestic Hot Water: 30 deg – 240 deg F with 2 deg F scale divisions.
  - 2. Domestic Cold Water: 30 deg – 180 deg F with 2 deg F scale divisions.
- H. Manufacturer: Subject to compliance with requirements, provide glass thermometers of one of the following:
  - Ashcroft
  - Marshalltown Instruments, Inc.
  - Mijoco Corporation
  - Taylor
  - 3M
  - Trerice (H.O.) Co.
  - Weiss Instruments, Inc.
  - Winter's Thermogauges

## 2.2 DIRECT MOUNT DIAL THERMOMETERS

- A. General: Provide direct mount dial thermometers of materials, capacities, and range indicated, designed and constructed for use in service indicated.
- B. Type: Vapor tension, universal angle.
- C. Case: Drawn steel or brass, clear acrylic plastic lens, minimum 4-1/2" diameter above 6'-0" above floor, 3-1/2" below 6'-0" above floor.
- D. Adjustable Joint: Die cast aluminum, 180 deg adjustment in vertical plane, 360 deg adjustment horizontal plane, with locking device.
- E. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube, one scale division accuracy.
- F. Movement: Brass precision geared.
- G. Scale: Progressive, satin faced, non-reflective aluminum, permanently etched markings.
- H. Stem: Copper plated steel, or brass, for separable socket, length to suit installation.
- I. Range: Conform to the following:
  - 1. Domestic Hot Water: 40 deg – 240 deg F
  - 2. Domestic Chilled Water: 30 deg – 180 deg F. (0 deg – 80 deg C).
- J. Manufacturer: Subject to compliance with requirements, provide direct mount dial thermometers of one of the following:
  - Marsh Instrument Co.,; Unit of General Signal.
  - Mijoco Corporation
  - Trerice (H.O.) Co.
  - Weiss Instruments, Inc.
  - Winters Thermogauges

## 2.3 THERMOMETER WELLS

- A. General: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2" extension for insulated piping. Provide cap nut with chain fastened permanently to thermometer wall.
- B. Manufacturer: Same as thermometers.

## 2.4 TEMPERATURE GAGE CONNECTOR PLUGS

- A. General: Provide temperature gage connector plugs, where indicated, pressure rated for 500 psi and 200 deg F (93 deg C). Construct of brass and finish in nickel-plate, equip with 1/2" NPS fitting, with self-sealing valve core type neoprene gasketed orifice suitable

for inserting 1/8" O.D. probe assembly from dial type insertion thermometer. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

- B. Manufacturer: Subject to compliance with requirements, provide temperature gage connector plugs of one of the following:  
Peterson Equipment Co.  
SISCO  
Trexco (H.O.) Co.

## 2.5 PRESSURE GAGES

- A. General: Provide pressure gages of materials, capacities, and range indicated, designed and constructed for use in service indicated.
- B. Type: General use, 1% accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.
- C. Case: Drawn steel clear acrylic plastic lens, minimum 4-1/2" diameter above 6'-0" above floor, 3-1/2" below 6'-0" above floor.
- D. Connector: Brass with 1/4" male NPT. Provide protective siphon when used for steam service. Provide shutoff cock.
- E. Scale: White coated aluminum, with permanently etched markings.
- F. Range: Conform to the following. Where more than one range is indicated, select for normal operation at midpoint. Select all gages for same service with same range.
1. Vacuum: 30" Hg – 10 psi.
  2. Water: 0 – 30 psi.  
0 – 60 psi.  
0 – 100 psi.  
0 – 160 psi.  
0 – 200 psi.
- G. Manufacturer: Subject to compliance with requirements, provide pressure gages of one of the following:  
Ashcroft  
Marsh Instrument Co.; Unit of General Signal.  
Marshalltown Instruments, Inc.  
Mijoco Corporation  
Taylor  
3M  
Trexco (H.O.) Co.  
Weiss Instruments, Inc.  
Winter's Thermogauges

## 2.6 PRESSURE GAGE COCKS

- A. General: Provide pressure gage cocks between pressure gages and gage tees on piping systems. Construct gage cock of brass with 1/4" female NPT on each end, and "T" handle brass plug.
- B. Syphon: 1/4" straight coil constructed of brass tubing with 1/4" male NPT on each end.
- C. Snubber: 1/4" brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
- D. Manufacturer: Same as for pressure gages.

## 2.7 PRESSURE GAGE CONNECTOR PLUGS

- A. General: Provide pressure gage connector plugs pressure rated for 500 psi and 200 deg F (93 deg C). Construct of brass and finish in nickel-plate equip with 1/2" NPS fitting, with

self-sealing valve core type neoprene gasketed orifice suitable for inserting 1/8" O.D. probe assembly from dial type insertion pressure gage. Equip orifice with gasketed screw cap and chain. Provide extension, length equal to insulation thickness, for insulated piping.

- B. Manufacturer: Subject to compliance with requirements, provide pressure gage connector plugs of one of the following:

Peterson Equipment Co.

SISCO

Treerice (H.O.) Co.

## 2.8 FLOW METER FITTINGS

- A. General: Provide as indicated flow meter fitting measuring stations furnished with a probe which senses both dynamic upstream pressure and static downstream pressure to determine a differential pressure. The probe shall be constructed of 304 stainless steel with a brass block and brass valves and be rated at a maximum working pressure of 150 psig at 250 deg F. Provide with a metal nameplate attached with a chain for identification. System losses shall not exceed one foot and the combined accuracy of the flow measuring station and manometer type readout instrument shall be within +/-2%.

- B. Manufacturer: Subject to compliance with requirements, provide wafer-type flow meter fittings of one of the following:

Gerand

Taco, Inc. (Sentinel)

## PART 3 - EXECUTION

### 3.1 THERMOMETER APPLICATIONS

- A. Install thermometers in the outlet of each domestic, hot-water storage tank.
- B. Install thermometers at suction and discharge of each pump.
- C. Provide the following temperature ranges for thermometers:
1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
  2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

### 3.2 GAGE APPLICATIONS

- A. General: Install pressure gages in piping tee with pressure gage cock located on pipe at most readable position. Pressure gages shall be installed so as to indicate pressure changes across equipment only. They must have connections installed as close as possible to equipment flanges.
- B. Locations: Install in locations as shown on the drawings and elsewhere as indicated:
1. At discharge of each pressure reducing valve.
  2. At water service outlet
- C. Pressure Gage Cocks: Install in piping tee with snubber. Install siphon for steam pressure gages.
- D. Pressure Gage Connector Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

### 3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

- C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- E. Install remote-mounting pressure gages on panel.
- F. Install needle-valve and snubber fitting in piping for each pressure gage.
- G. Install test plugs in tees in piping.
- H. Install permanent indicators on walls or brackets in accessible and readable positions.
- I. Install connection fittings for attachment to portable indicators in accessible locations.
- J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.
- K. Adjust faces of thermometers and gages to proper angle for best visibility.
- L. General: Install temperature gages in vertical upright position, and tilted so as to be easily read by observer standing on floor.

### **3.4 ADJUSTING AND CLEANING OF METERS AND GAGES**

- A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.
- B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked, broken or severely scratched windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

**END OF SECTION 22 0519**

## SECTION 22 0523

### GENERAL DUTY VALVES AND STRAINERS FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

##### 1.2 DESCRIPTION OF WORK

- A. Extent of valves required by this section are indicated on drawings and/or specified in other Division 22 sections.
- B. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

##### 1.3 QUALITY ASSURANCE

- A. Valve Types: Provide valves of same type by same manufacturer.
- B. Valve Identification: Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- C. Codes and Standards:
  - 1. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions".
  - 2. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves".
  - 3. FCI Compliance: Test and rate "Y" type strainers in accordance with FCI 73-1 "Pressure Rating Standard for "Y" Type Strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than "Y" Type".
  - 4. ASME Compliance:
    - a. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
    - b. ASME B31.1 for power piping valves.
    - c. ASME B31.9 for building services piping valves.
  - 5. NSF Compliance: NSF 61 for valve materials for potable-water service.

##### 1.4 SUBMITTALS

- A. Include pressure drop curve or chart for each type and size of valve and strainer. Submit schedule showing manufacturer's figure number, size, location and features for each required valve and strainer. Indicate sizes being supplied.

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

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set angle, gate, and globe valves closed to prevent rattling.
  - 4. Set ball and plug valves open to minimize exposure of functional surfaces
  - 5. Set butterfly valves closed or slightly open.
  - 6. Block check valves in either closed or open position.

- B. Use the following precautions during storage:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

## 1.6 DEFINITIONS

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

## PART 2 - PRODUCTS

### 2.1 VALVES

- A. General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections.
- B. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
- C. Operators: Unless otherwise specified provide handwheels, fastened to valve stem, for valves other than quarter-turn. Unless otherwise indicated, provide lever handle for quarter-turn valves, 6" and smaller, other than plug valves. Provide one wrench for every 10 plug valves. Provide gear operators for quarter-turn valves 8" and larger. Provide chain-operated sheaves and chains for overhead valves as indicated.
- D. Gate Valves 2" and smaller shall be 150# W.S.P., bronze, screwed pattern with rising stem, union bonnet, single wedge disc. Valves shall conform to MSS SP-80. Valves shall be Crane 428-UB, Hammond IB-617, Lunkenheimer 3127, Stockham B-105, Milwaukee 1152, Legend T-416, or Nibco T-134.
- E. Gate Valves 2-1/2" and larger shall be 125# W.S.P., cast iron, outside screw and yoke, flanged pattern with bolted bonnet, rising stem, bronze seats, stem and disc faces. Valves shall conform to ASTM specification A-126 and federal specification WW-B-58, Type I, Class 1. Valves shall be Crane 465-1/2, Hammond IR 1140, Lunkenheimer 1430, Stockham G-623, Milwaukee F2885, Legend T-303, or Nibco F-617-0.
- F. Check Valves 2" and smaller shall be 150# W.S.P., Y-pattern, bronze, swing check, screwed/soldered pattern. Valves shall conform to ASTM specification B-62 and MSS SP-80. Valves shall be Crane 37/150, Milwaukee 507/508, Nibco S-433/T-433, Stockham B-321, Legend T/S 453, or Watts CVY/CVYS.
- G. For domestic water piping, check valves 2" and smaller shall be 200# W.D.G., bronze, spring loaded in-line check valve, and can be installed in any position. Valves shall be Nibco S-480, Legend T/S-455, Crane, Milwaukee, or Stockham.
- H. Check Valves 2-1/2" and larger shall be 125# W.S.P., cast iron, flanged pattern with all bronze trim. Valves shall conform to ASTM specification A-126. Valves shall be Crane 373, Hammond IR-1124, Lunkenheimer 1790, Jenkins 624, Stockham G- 931, Milwaukee F2974, Powell 559, Legend T-311, or Nibco F-918-B.
- I. Ball Valves 2" and smaller shall be 150 psi saturated steam rated; 600 psi non-shock cold water, oil or gas rated; two-piece body; chrome plated ball; blowout proof stem; reinforced TFE seats; full port design in all sizes; bronze or brass body; all 316 stainless steel trim on valves used for steam service; screwed/soldered pattern. Valves shall be Nibco 585-70,



- Apollo 77-100/200, Watts B-6080, Milwaukee BA-125/155 or Legend T/S-1002 ST/TS-1002.
- J. Ball valves installed in domestic cold water systems shall have an extended handle which offers vapor seal, adjustable memory stop, and valve packing maintenance without disturbing the insulation. This handle shall be equal to Nibseal by Nibco, Inc. The piping handle shall have a temperature range from -50 to 250 deg F.
  - K. Ball Valves 2-1/2" through 3" size shall be 150 psi saturated steam rated; 600 psi non-shock cold water, oil or gas rated; two-piece body; chrome plated ball; blowout proof stem; reinforced TFE seats; conventional port design in all sizes; bronze or brass body; all 316 stainless steel trim on valve used for steam service; screwed pattern. Valves shall be Nibco 580-70, Apollo 70-100/200, Watts B-6000, Milwaukee BA-100S, or Legend T/S-1002 ST/TS-1002.
  - L. Air Vents and Drains for main water lines shall be bronze, screwed/soldered pattern ball valves with a 3/4" male hose thread adaptor. The hose thread adaptor shall have a metal cap with a rubber washer. Valves shall be Apollo 70-100.
  - M. Flow Measuring Balance Valves, in piping 2" and smaller shall be one piece, non-ferrous, bronze/brass flow measuring and balancing/shut-off valve combination with NPT screwed pattern connections. The flow element shall be a low loss/high signal venturi type, or "Y" pattern globe type with a minimum measuring accuracy of +/- 7% within the normal setting range of the valve, equipped with dual integral self-sealing differential pressure test ports and caps. All balance valves shall provide 100% positive, dead end leakproof shutoff against the same fluid temperature and pressure ratings as the body. Minimum body ratings are 235 psi at 300 deg. F. Balance valves shall include a memory stop to ensure return to the balanced position after shutoff. An enclosed anti-tamper lock feature shall prevent handwheel repositioning after setting. Ball type valves shall include large diameter plated ball, Teflon seats, blow out proof stem with Teflon packing and packing nut, and full size handle. "Y" pattern globe types shall include maintenance free O-ring, and calibrated direct reading of flow on valve stem arrangement. Flow measuring balance valves in piping 2" and under shall be sized to perform in a normal operation range between 25% and 100% of the full open position, at a minimum pressure differential between 1 and 3 ft. WG, but in no case shall be more than one size smaller than the indicated connecting pipe size. Valves shall be Accusetter by Flow Design, Inc., Tour and Andersson, or MEPCO.
  - N. Strainers 2" and smaller shall be 250#, cast iron body, screwed pattern with 20 mesh stainless steel or Monel screens, strainers to be Muessco No. 11, Armstrong, legend T-17, Crane, Sarco, MEPCO or Metraflex.
  - O. Strainers, 2-1/2" and larger shall be 125#, cast iron body, flanged pattern with perforated brass screens with 1/16" openings. Screen retainers to be drilled to receive 1-1/4" or larger drain valves. Strainers to be Muessco No. 758 thru 8" size, No. 758-HC - 10" and larger; Armstrong, Legend T-19, Crane, Sarco, MEPCO or Metraflex, SF Group.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

### **3.2 INSTALLATION OF VALVES**

- A. Valves shall be provided in suitable locations at each item of equipment, branch circuit, riser, or section of piping as indicated or required for proper and safe operation of the system and to facilitate maintenance and/or removal of all equipment and apparatus. On horizontal pipe runs, install all valve stems vertically up where possible and in no case shall the stems be turned more than 90 degrees from the vertically up position.
- B. Install valves in compliance with manufacturer's installation instructions.
- C. Potable water systems (2" and smaller) shall utilize valves as indicated with soldered connections where used for zone isolation, or threaded connections when used in conjunction with a union for equipment isolation
- D. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.
- E. Potable water systems (2-1/2" and larger) shall utilize valves with flanged connections.
- F. For gear operated valves: The valve is normally shipped with the handwheel loose, the installing contractor or mechanic must take care to ensure the roll pin that holds the handwheel to the input shaft of the gear operator is installed completely, and is balanced on both sides of the handwheel. The fit of the pin in the handwheel and the shaft is controlled and should provide years of reliable service.
- G. Make sure check valves are oriented properly for flow and gravity effect, and that they are distant from pump outlets or other turbulence inducing devices.

### **3.3 INSTALLATION OF STRAINERS**

- A. Install blowdown valves on all strainers 1-1/2" and larger. Blowdown valves to be ball valves for hydronic piping and gate valves for steam and steam condensate piping. Strainer blowdown valves to be sized to match blowdown connection size, but not less than 3/4". Terminate blowdown with hose thread connection and cap or plug.
- B. Unless otherwise indicated, install all strainers with wye pattern vertically down.

**END OF SECTION 22 0523**

**SECTION 22 0529**  
**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
  - 1. Division 22, Section "Common Work Results for Plumbing".

**1.2 DESCRIPTION OF WORK**

- A. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 22 sections.
- B. Types of supports and anchors specified in this section include the following:
  - Horizontal - Piping Hangers and Supports.
  - Vertical - Piping Clamps.
  - Hanger - Rod Attachments.
  - Building Attachments.
  - Saddles and Shields.
  - Miscellaneous Materials.
  - Anchors.
  - Equipment Supports
- C. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

**1.3 DEFINITIONS**

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

**1.4 PERFORMANCE REQUIREMENTS**

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

**1.5 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of type and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
  - 1. Code Compliance: Unless requirements are exceeded herein, comply with applicable codes pertaining to product materials and installation of supports and anchors.
  - 2. Comply with NFPA 13 for hangers and supports used as components of fire protection systems. Include listing and labeling by UL and FM.
  - 3. Factory fabricate hangers, supports, and components according to MSS SP-58.

**1.6 SUBMITTALS**

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support. Submit pipe hanger and support schedule showing

- manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support, indicating dimensions, weights, required clearances, and methods of assembly of components.

## **PART 2 - PRODUCTS**

### **2.1 HORIZONTAL - PIPING HANGERS AND SUPPORTS**

- A. General: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type of one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems. Provide felt lined hangers or clamps for uninsulated refrigerant piping to eliminate transmission of sound and vibration. Perforated strap hangers shall not be used in any work.

### **2.2 VERTICAL-PIPING CLAMPS**

- A. General: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with MSS SSP-58, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

### **2.3 HANGER-ROD ATTACHMENT**

- A. General: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

### **2.4 BUILDING ATTACHMENTS**

- A. General: Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, expansion shells, inserts or beam clamps selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. All beam clamps shall be installed with a retaining strap to grasp two opposing sides of structure to prevent possible movement of the clamp due to vibration. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems. "C" clamps shall not be permitted except on fire protection piping.

### **2.5 MANUFACTURERS OF HANGERS AND SUPPORTS**

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:  
B-Line Systems, Inc.  
Globe Hanger  
ITT Grinnell Corp.  
Michigan Hanger  
Modern Hanger  
PHD Manufacturing, Inc.

## 2.6 SADDLES AND SHIELDS

- A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. See PART 3 for application.
- B. Saddles: Install MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation. Utilize hardwood block saddle (minimum 6" long), with sufficient width to prevent hanger bearing on insulation for cold water piping saddles.
- C. Shields: Install MSS Type 40, protective shields. Shields shall span an arc of 180 degrees, and have a length of 12 inches, thickness of 0.048 inches for piping under 4 inches diameter; length of 12 inches, thickness of 0.060 inches for piping 4 inches diameter; and length of 18 inches, thickness of 0.060 inches for piping 5 and 6 inches in diameter.
- D. Thermal Hanger Shield Inserts:
  - 1. Constructed of 360 deg insert of high density, 100 psi, water-proofed calcium silicate, encased in 360 deg sheet metal shield. Provide assembly of same thickness as adjoining insulation, with sufficient width to prevent hanger bearing on insulation.

## 2.7 MISCELLANEOUS MATERIALS

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards. Material coatings for interior use shall be electro-plated zinc (ASTM B633), or mill galvanized (ASTM A525 G90). For exterior use, materials shall be hot-dip galvanized after fabrication (ASTM A386).
- D. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex-head, track bolts and nuts. Use galvanized or stainless steel for use in moist environments.

## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### 3.2 PREPARATION

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

### 3.3 INSTALLATION OF BUILDING ATTACHMENTS

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated below. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. For new concrete, install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.
- B. Two or one-end threaded rod sizing for various support loads shall be as follows:

ROD DIAMETER	MAXIMUM LOAD (LBS.)
3/8"	610

1/2"	1130
5/8"	1810
3/4"	2710
7/8"	3770
1"	4960
1-1/8"	6230

Note limitations on structure supporting rods.

- C. For reference purposes, the following table provides filled weights of steel piping for various sizes:

PIPE SIZE	FILLED PIPE WEIGHT (LB/FT)
1/2"	1.0
3/4"	1.4
1"	2.1
1-1/4"	3.0
1-1/2"	3.6
2"	5.1
2-1/2"	7.9
3"	10.8
4"	16.3
6"	31.5
8"	50.2
10"	74.6
12"	98.6

- D. Unless hanger spacing is

1. specifically indicated on drawings
2. indicated in other Division 22 specification sections for special applications
3. required to be more frequently by State or local codes

all piping shall be supported at distances not exceeding the spacing in the following table. This table is intended for general distribution piping. Within equipment rooms, hangers must be arranged to provide full support of piping. No piping is to be supported by, or impose a load upon the equipment to which it is connected.

HANGER SPACING TABLE		
PIPING MATERIAL	MAX. HORIZONTAL SPACING (FEET) <sup>4</sup>	MAX. VERTICAL SPACING (FEET) <sup>4</sup>
ABS Pipe	4	4
Aluminum Tubing	10	15
Brass Pipe	10	10
Brass Tubing, 1-1/4" Dia. & Smaller	6	10
Brass Tubing, 1-1/2" Dia. & Larger	10	10
Cast-Iron Pipe <sup>1</sup>	5	15
Copper or Copper-Alloy Pipe	12	10
Copper or Copper-Alloy Tubing, 1-1/4" Dia. & Smaller	6	10
Copper or Copper-Alloy Tubing, 1-1/2" Dia. & Larger	10	10
CPVC Pipe or Tubing, 1" Dia. & Smaller	3	4 <sup>2</sup>
CPVC Pipe or Tubing, 1-1/4" Dia. & Larger	4	4
Galvanized Steel Pipe	12	15
Lead Pipe	Continuous	4
PB Pipe or Tubing	2.67 (32")	4
PVC Pipe	4	4
Steel Pipe	12	15
Steel Tubing	8	10
Gas Piping <sup>3</sup>		
Rigid Pipe, 3/4" Dia. and Under	10	----
Rigid Pipe, 1" Dia. & Over	12	----
Tubing, 1-1/2" Dia. & Under	6	----
Tubing, 1-1/2" Dia. & Over	10	----
Footnotes:		
<ol style="list-style-type: none"> <li>1. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed.</li> <li>2. Install mid-story guide.</li> <li>3. Gas piping horizontal maximum hanger spacing shall be the lesser of that indicated for the specific material utilized or that indicated for gas piping. Maximum vertical spacing shall be that indicated for the material utilized.</li> <li>4. 1 foot = 304.8 mm.</li> </ol>		

### 3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Support plumbing piping independently of other piping.
- D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.
- E. Provisions for Movement:
  - 1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.
- F. Pipe Slopes: Install hangers and supports to provide indicated or specified pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
- G. Horizontal Piping: Comply with the following installation requirements.
  - 1. Individual hangers for uninsulated piping not specified to be supported with roller hangers may be supported with either adjustable band hangers or adjustable steel clevis hangers.
  - 2. Individual hangers for insulated piping not specified to be supported with roller hangers shall be adjustable steel clevis hangers.
  - 3. Support the following horizontal piping using adjustable roller hanger supports MSS Type 43 for twelve (12) inches and below and MSS Type 41 for fourteen (14) inches and above:
    - a. Piping over 2 inches in size transporting medium above 150 deg. F.
    - b. All piping 4 inches in size and above, regardless of medium.
    - c. All piping on horizontal trapeze supports.
  - 4. Heavy duty trapezes may be utilized for multiple horizontal pipes where applicable. Design of same shall be by trapeze manufacturer considering weight, available structure, pipe medium, material, etc. Supports for individual piping group on trapezes shall be as specified for individual piping.
- H. Insulated Piping: Comply with the following installation requirements.
  - 1. Clamps: At contractor's option to shields, where flexible elastomeric insulation is indicated on piping size two (2) inches and under, attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
  - 2. Saddles: Where piping is insulated and piping is eight (8) inches in diameter or larger, or piping of any size on roller hanger supports, install protection saddles. Fill interior voids with segments of insulation matching adjoining insulation.
  - 3. Shields: Where insulation is indicated on piping, install galvanized protective shields for sizes 6" and smaller. Install thermal hanger shield inserts with same thickness as pipe insulation.

### 3.5 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.



- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### **3.6 EQUIPMENT SUPPORTS**

- A. Provide painted structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands.
- B. Provide grout under supports as required to bring piping and equipment to proper level and elevations.

### **3.7 ADJUSTING AND CLEANING**

- A. Hanger Adjustments: Adjust hangers so as to distribute loads equally on attachments and to achieve slope of pipe.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

**END OF SECTION 22 0529**

## SECTION 22 0553

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Stencils.
  - 5. Valve tags.
  - 6. Warning tags.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

##### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### PART 2 - PRODUCTS

##### 2.1 PIPING AND EQUIPMENT IDENTIFICATION MATERIALS:

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installers option, but provide single selection for each product category.

##### 2.2 PLASTIC PIPE MARKERS

- A. Snap-On-Type: Provide manufacturer's standard preprinted, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

- C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 deg around pipe at each location, fastened by one of the following methods:
  - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
  - 2. Adhesive lap joint in pipe marker overlap.
  - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
  - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- D. Lettering: Comply with piping system nomenclature as described in ANSI A13.1 and abbreviated only as necessary for each application length.
  - 1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
- E. Background Colors and Legend: Furnish piping identification in colors conforming to the following schedule:

LEGEND WORDING	MARKER COLORS
Compressed Air	Y
Deionized Water	GW
Distilled Water	GW
Domestic Cold Water	GW
Domestic Hot Water	Y
Drain (A/C Condensate)	GW
Fire Protection Water	R
Fuel Oil	Y
Medical Air	B
Natural Gas	Y
Nitrogen	GW
Nitrous Oxide	Y
Oxygen	Y
Plumbing Vent	GW
Sanitary Drain	GW
Sanitary Sewer	GW
Storm Drain	GW
Storm Sewer	GW
Medical Vacuum	Y
#10 Oil	Y
#30 Oil	Y
Hydraulic Fluid	Y

Y = Yellow with Black Letters  
 GW = Green with White Letters  
 R = Red with White Letters  
 B = Blue with White Letters

**2.3 PLASTIC TAPE**

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any of less than 6"), 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

## 2.4 UNDERGROUND TYPE PLASTIC LINE MARKERS

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.
  - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.

## 2.5 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32" hole for fastener.
  - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
- B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick, engraved, color coded plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
  - 1. Provide 1-1/2" square tags with color coded lettering and backgrounds as required for the piping serviced. Provide a separate background color for each major piping group (e.g., chilled water, heating water, etc).
- C. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.
- D. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

## 2.6 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with plastic (plexiglass) panel.
- B. Submit valve schedule for Engineer's review prior to mounting.

## 2.7 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, equipment markers.
- B. Nomenclature: Include the following:
  - 1. Name and owner's equipment identification number.
  - 2. Equipment service.
- C. Size: Provide approximate 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

## 2.8 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
  - Allen Systems, Inc.
  - Brady (W.H.) Co.; Signmark Div.
  - Industrial Safety Supply Co., Inc.
  - Lab Safety Supply
  - Seton Name Plate Corp.

## 2.9 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Reinforced grommet and wire or string.
  - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.3 PIPE LABEL INSTALLATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
  - 1. Stenciled markers, including color-coded background band or rectangle, and contrasting lettering of black or white. Extend color band or rectangle 2" beyond ends of lettering.
  - 2. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
  - 3. Stenciled markers, black or white for best contrast, wherever continuous color-coded painting of piping is provided.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

### 3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, and shut-off valves at plumbing fixtures. HVAC terminal device and

similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

- B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

### **3.5 MECHANICAL EQUIPMENT IDENTIFICATION**

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
  - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  - 2. Meters, gages, thermometers and similar units.
  - 3. Fuel-burning units.
  - 4. Pumps, compressors, and similar motor-driven units.
  - 5. Tanks and pressure vessels.
  - 6. Strainers, filters, water treatment systems and similar equipment.
- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at installer's option.
- C. Lettering Size: Minimum ¼" high lettering for name of unit where viewing distance is less than 2'-0", ½" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to ¾ of size of principal lettering.
- D. Text of Signs: In addition to the name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- E. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceiling or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).

- 3.6 Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

### **3.6 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

### **3.7 UNDERGROUND PIPING IDENTIFICATION**

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

### **3.8 CONFINED SPACE IDENTIFICATION:**

- A. Furnish and install confined space identification signs in a conspicuous location where approved by Owner's authorized representative for each permit required confined space. A permit required confined space is defined as a confined space in which an employee's whole body can enter, has an entrance into or exit from the space which is restricted in anyway, and is not designed for continuous employee occupancy. In addition, a permit

required confined space must have the potential to contain a hazardous atmosphere, contain a material such as fluid or particles that could trap or asphyxiate an entrant, or contain any other serious safety or health hazard, such as an electrical or mechanical hazard. Examples of permit required confined spaces requiring signs are air handling units, boilers, cooling tower sumps, underground tanks, vaults or manholes, etc.

**3.9 ADJUSTING AND CLEANING OF MECHANICAL IDENTIFICATION:**

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

**END OF SECTION 22 0553**

**SECTION  
22 0700 - PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds, as applicable to this project.
- B. Related sections include the following:
  - 1. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe insulation shields and protection saddles.

**1.3 SUBMITTALS**

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show typical fabrication and installation details for the following as applicable:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.
- C. Samples: For each type of insulation and jacket. Identify each sample, describing product and intended use. Submit samples in the following sizes:
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Sheet Form Insulation Materials: 12 inches square.
  - 3. Jacket Materials: 12 inches long by NPS 2.
- D. Manufacturer's Color Charts: Show the full range of colors available for each type of field-applied finish material indicated.

**1.4 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 3 years successful installation experience on projects with mechanical insulations similar to that required for this project.
- C. Fire-Test-Response Characteristics: as determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.



1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Protect insulation against dirt, water, chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site. Insulation made wet or damaged even after installation shall be removed and replaced.

## **1.6 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
- B. Coordinate clearance requirements with piping installer for insulation application.
- C. Coordinate installation and testing of heat tracing.

## **1.7 SCHEDULING**

- A. Schedule insulation application after testing piping systems and, where required, after installing and testing heat-trace tape. Insulation application may begin on segments of piping that have satisfactory test results.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

1. Mineral-Fiber Insulation:

CertainTeed Manson.  
Knauf FiberGlass GmbH.  
Owens-Corning Fiberglas Corp.  
Johns Manville

### **2.2 INSULATION MATERIALS**

- A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
  1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1 up to 850 deg F, (ASTM C547 Type II for operating temperatures from 850 to 1200 deg F), max k=0.25 at 100 F mean with factory-applied, all-purpose vapor-retarder jacket.
  2. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
    - a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
    - b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
  3. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
  4. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
  5. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.

6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
- B. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- C. The use of PolyBrominated Diphenyl Ethers (PBDE) chemicals when added to plastic and foam products as a flame retardant in plumbing pipe insulation/jacket is prohibited.

## **2.3 FIELD-APPLIED JACKETS**

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.
  1. Adhesive: As recommended by insulation material manufacturer.
  2. PVC Jacket Color: White or gray.
  3. PVC Jacket Color: Color-code piping jackets based on materials contained within the piping system. Coordinate color requirements with Architect/Engineer.
- C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
  1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
  2. Adhesive: As recommended by insulation material manufacturer.
- D. The use of PolyBrominated Diphenyl Ethers (PBDE) chemicals when added to plastic and foam products as a flame retardant in plumbing pipe insulation/jacket is prohibited.

## **2.4 ACCESSORIES AND ATTACHMENTS**

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd.
  1. Tape Width: 4 inches.
- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  2. Galvanized Steel: 0.005 inch thick.
  3. Aluminum: 0.007 inch thick.
  4. Brass: 0.010 inch thick.
  5. Nickel-Copper Alloy: 0.005 thick.
- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.

## **2.5 VAPOR RETARDERS**

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system. Unless otherwise indicated, furnish and install insulations of the same type for the same service throughout this work.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials clean and dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- J. Apply insulation with the least number of joints practical.
- K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties. Insulate flanges, unions, strainer outlets and plug valves with pressure fit removable and replaceable covers. Do not restrict valve operation in any way.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: Taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder, and to seal fiberglass. No exposed fiberglass will be permitted.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

- a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
- 4. Vapor Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
- 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- P. Roof Penetrations: Unless otherwise detailed, apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal metal jacket to roof flashing with vapor retarder mastic.
- Q. Exterior Wall Penetrations: Unless otherwise detailed, for penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.
- R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partition. Refer also to sound stopping requirements.
- S. Fire-Rated Wall and Partition Penetrations: Apply insulation through penetrations of fire-rated walls and partitions. Refer to drawing details and fire and sound stopping specification requirements.
- T. Floor Penetrations: Apply insulation continuously through floor assembly.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder. Maintain fire rating as applicable.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.
  - 3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  - 4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
  - 1. Apply preformed pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  - 4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
  - 5. See flexible elastomeric insulation application for additional flange insulation information.
- C. Apply insulation to fittings and elbows as follows:
  - 1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  - 2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.

3. Cover fittings with standard PVC fitting covers. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retardant mastic.
  4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
  3. Apply insulation to flanges as specified for flange insulation application.
  4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
  5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor retarder mastic.
  6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.
  7. See flexible elastomeric insulation application for additional valve and specialty information.

### 3.5 FIELD APPLIED JACKET APPLICATION

- A. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive for a completely sealed waterproof installation. Completely sealed system shall comply with requirements of USDA and FDA.

### 3.6 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment as applicable:
1. Flexible connectors on other than cold piping systems.
  2. Fire-suppression piping (exclusive).
  3. Drainage piping located in crawl spaces, unless otherwise indicated.
  4. Below-grade piping, unless otherwise indicated.
  5. Chrome-plated pipes and fittings, unless potential for personnel injury.
- C. Plumbing Insulation Omitted: Unless otherwise indicated, omit insulation on chrome-plated exposed piping, shock absorbers, unions, strainers, check valves, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, and pre-insulated equipment. See plumbing specifications for possible additional insulation requirements. Trap primer insulation may be omitted on trap primer piping in walls or underground.

### 3.7 FIELD QUALITY CONTROL

- A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:

1. Inspect insulation assembly of fittings and valves randomly selected by Architect/Engineer.
- B. Insulation applications will be considered defected if sample inspection reveals noncompliance with requirements. Remove defective Work and replace with new materials according to these Specifications.
- C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.
- D. All wet or damaged insulation shall be removed and replaced.

### **3.8 INSULATION APPLICATION SCHEDULE, GENERAL**

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements. Where more than one material is indicated for a particular service, choice of listed material is installer's option, unless otherwise specifically indicated.

### **3.9 INTERIOR PIPE INSULATION APPLICATION SCHEDULE**

- A. Domestic Hot and Recirculated Water Piping (60 to 140 deg F):
  1. Mineral fiber with all service jacket, 1 inch thick, sizes 1 inch and lower; 1-1/2 inch thick sizes, 1-1/4 inch to 2 inches; 2 inch thick, sizes 2-1/2 inches and above.
    - a. with PVC jacket (where exposed above 12' AFF).
- B. Domestic Cold Water Piping (35 to 60 deg F):
  1. Mineral fiber with vapor retardant all service jacket; 1 inch thick.
    - a. with PVC jacket (where exposed above 12' AFF).

**END OF SECTION 22 0700**

**SECTION 22 1120**  
**PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This section includes plumbing piping systems to a point 5 ft. outside the building. Systems include the following:
  - 1. Potable water distribution, including cold- and hot-water supply.
  - 2. Plumbing drainage and vent systems.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 22 Section "Common Work Results for Plumbing" for piping installation.
  - 2. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages and fittings.
  - 3. Division 22 Section "Identification for Plumbing Piping and Equipment" for labeling and tags.

**1.3 DEFINITIONS**

- A. The following are industry abbreviations for plastic piping materials:

**1.4 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Provide components and installation capable of producing piping systems with the following minimum working pressure ratings, except where indicated otherwise:
  - 1. Water Distribution Systems, Below Ground: 150 psig.
  - 2. Water Distribution and Oil Systems, Above Ground: 125 psig.
  - 3. Soil, Waste, and Vent Systems: 10 ft. head of water, or as required by local code.
  - 4. Storm Drainage Systems: 10 ft head of water, or as required by local code.
  - 5. Sanitary Sewage, Pumped Piping Systems: 75 psig.
  - 6. Storm Sewage, Pumped Piping Systems: 75 psig.

**1.5 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.
- B. Product data for plumbing piping products.
- C. Water samples, test results, and reports specified in "Field Quality Control" and "Cleaning" Articles.
- D. Coordination drawings, drawn accurately to scale and coordinating penetrations.

**1.6 QUALITY ASSURANCE**

- A. Comply with the provisions of ASME B31.9 "Building Services Piping" for materials, products, and installation.
- B. Comply with the provisions of applicable state, county, or local plumbing codes for materials, products and installation.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects", Sections 1 through 9 for potable-water piping and components.
- D. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems.

## **PART 2 - PRODUCTS**

### **2.1 PIPES AND TUBES**

- A. General: The application of the following pipe, tube, and fitting materials and joining methods required for plumbing piping systems are indicated in Part 3 Article "Pipe and Fittings Applications"
- B. PolyVinyl Chloride (PVC) Plastic, DWV Pipe: ASTM D 17852665, Schedule 40, plain ends.
- C. Cross-linked Polyethylene (PEX): ASTM 876 and ASTM F877, Type A

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

- A. PolyVinyl Chloride (PVC) Plastic, DWV Pipe Fittings: ASTM D 2665, made to ASTM D 3311; socket type; drain, waste, and vent pipe patterns.
- B. PolyVinyl Chloride (PVC) Plastic, Schedule 80, Socket Type Pipe Fittings: ASTM D 2467.
- C. Press Fittings: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
- D. Cross-Linked Polyethylene (PEX), ASTM F1960 cold expansion fittings.

### **2.3 VALVES and STRAINERS**

- A. Refer to Division 22 Section "General Duty Valves and Strainers for Plumbing Piping" for general duty valves and strainers.

## **PART 3 - EXECUTION**

### **3.1 EXCAVATION**

- A. Excavation, trenching, and backfilling are specified in (Division 22 Section "Common Work Results for Plumbing").

### **3.2 PIPE AND FITTINGS APPLICATIONS**

- A. General: Use pipe, tube, fittings, and joining methods for piping systems according to the following applications.
- B. Water Distribution Piping Below Ground: Use the following:
  - 1. 4 to 12 Inches: Ductile iron pipe, ductile iron or gray iron fittings, rubber gaskets, and mechanical joints.
  - 2. 2-1/2 and 3 Inches: Soft copper tube, Type L, cast copper alloy, solder-joint pressure fittings and soldered joints with Alloy Sn95, or E solder.
- C. Water Distribution Piping Above Ground: Use the following:
  - 1. 4 Inches and Smaller: Polyvinyl chloride (PVC) plastic schedule 40 pipe; PVC solvent weld CPVC ASTM D2846 joints.



2. 2 inches and smaller: Cross-linked polyethylene plastic for hot and cold water distribution with cold expansion fittings having reinforcing rings.
- D. Soil, Waste, and Vent Piping Below Ground: Use the following:
  1. 5 to 12 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8 inch and larger sizes; and solvent-cemented joints.
  2. 2 to 4 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
- E. Soil, Waste, and Vent Piping Above Ground: Use the following:
  1. 5 to 12 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8-inch and larger sizes; and solvent-cemented joints.
  2. 2 to 4 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
  3. 1-1/4 and 1-1/2 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
- F. Storm Drainage Piping Below Ground: Use the following:
  1. 5 to 12 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8-inch and larger sizes; and solvent-cemented joints.
  2. 2 to 4 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.
- G. Storm Drainage Piping Above Ground: Use the following:
  1. 5 to 12 Inches: Poly(vinyl chloride) (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings in 5- and 6-inch sizes; PVC socket-type Schedule 40 fittings in 8-inch and larger sizes; and solvent-cemented joints.
  2. 2 to 4 Inches: Polyvinyl chloride (PVC) plastic DWV pipe; PVC socket-type drain, waste, and vent pipe pattern fittings; and solvent-cemented joints.

### 3.3 PIPING INSTALLATION, GENERAL

- A. General Location and Arrangement: Drawings indicate general location and arrangement of piping systems. Install piping as indicated, except where deviations to layout are approved by the Engineer.
- B. Install components having pressure ratings equal to or greater than system operating pressure.
- C. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- D. Install piping free of sags and bends.
- E. Install interior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
- F. Install piping tight to slabs, beams, joists, columns, walls and other building elements. Allow sufficient space around removable ceiling panels to allow for ceiling panel removal.
- G. Install piping to allow application of insulation plus 1 inch clearance around insulation.
- H. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- I. Install fittings for changes in direction and branch connections.
- J. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber

- links required to make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for sleeves and mechanical sleeve seals.
- 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". PEX Tubing
  - L. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.
  - M. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, provide cover to portions of tubing exposed to direct sunlight.
  - N. Do not install PEX tubing within 6 inches of gas appliance vents or within 12 inches of any recessed light fixtures.
  - O. Do not solder within 18 inches of PEX tubing in the same waterline. Make sweat connections prior to making PEX connections.
  - P. Do not expose PEX tubing to direct sunlight for more than 30 days.
  - Q. Ensure no glues, solvents, sealants or chemicals come in contact with the tubing without prior permission from the tubing manufacturer.
  - R. Use grommets or sleeves at the penetration for PEX tubing passing through metal studs.
  - S. Protect PEX tubing with sleeves where abrasion may occur.
  - T. PEX riser installations require epoxy-coated riser clamps installed at the base of the ceiling per floor.
  - U. A mid-story support is required for riser applications.

#### **3.4 SERVICE ENTRANCE PIPING:**

- A. Extend water distribution piping and connect to water service piping of size and in location indicated for service entrance to building. Water service piping is specified in separate specification section.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at water service entrance.
- C. Water Service Pipe: Comply with AWWA C600. Install buried pipe inside building between shutoff valve, wall and floor penetrations, and point 5 feet outside building, with restrained joints, including anchoring pipe to wall or floor. Provide supports (thrust blocks) at vertical and horizontal offsets.
  - 1. Wrap pipe with polyethylene encasement.
- D. Extend building storm drain piping and connect to building storm sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building storm drain and building storm sewer. Storm sewerage piping is specified in separate Section.
- E. Extend building sanitary drain piping and connect to sanitary sewer piping of size and in location indicated for service entrance to building. Install cleanout and extension to grade at connection of building sanitary drain and building sanitary sewer. Sanitary sewerage piping is specified in separate Section.
- F. Install sleeve and mechanical sleeve seal at service penetrations through foundation wall for watertight installation.

### 3.5 WATER DISTRIBUTION PIPING INSTALLATION

- A. Install piping with 1/32-inch per foot (1/4 percent) slope downward toward drain.

### 3.6 DRAINAGE AND VENT PIPING INSTALLATION

- A. Install cast iron soil pipe and cast iron soil pipe fittings according to CISPI 1990 revised and edited edition of "Cast Iron Soil Pipe and Fittings Handbook, Volume I," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings".
- B. Make changes in direction for drainage and vent piping using appropriate wye branches, wye branches with 1/8 bends, and long-sweep 1/4, 1/5, 1/6, 1/8, and 1/16 bends. Sanitary tees and short-sweep quarter bends may be used on vertical stacks of drainage lines where change in direction of flow is from horizontal to vertical. Use long-turn double-wye-branch and 1/8 bend fittings where two fixtures are installed back to back or side by side and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Make no change in direction of flow greater than 90 degrees. Where different sizes of drainage pipes and fittings are connected, use proper size standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- C. Lay buried building drains beginning at low point of each system, true to grades and alignment indicated, with unbroken continuity of invert. Place hub or bell ends of piping facing upstream. Install required gaskets according to manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in piping and pull past each joint as completed.
- D. Install drainage and vent piping at the following minimum slopes, except where another slope is indicated:
  - 1. Sanitary Building Drain: 1/4 inch per foot (2%).
  - 2. Horizontal Sanitary Drainage Piping: 1/4 inch per foot (2%).
  - 3. Storm Building Drain: 1/8 inch per foot (1%).
  - 4. Horizontal Storm Drainage Piping: 1/4 inch per foot (2%).
  - 5. Vent Piping: 1/8 inch per foot (1%).
- E. Sleeves are not required for cast iron soil pipes passing through concrete slab, without membrane waterproofing, on grade.
- F. Install ABS drainage pipe and fittings according to ASTM D 2661.
- G. Install PVC drainage pipe and fittings according to ASTM D 2665.

### 3.7 JOINT CONSTRUCTION

- A. General: Join pipe and fittings as follows:
  - 1. Ream ends of pipe and tubes and remove burrs. Bevel plain ends of steel pipe.
  - 2. Remove scale, slag, dirt and debris for inside and outside of pipe and fittings before assembly.
  - 3. Solder Joints: Construct joints according to AWS "Soldering manual", Chapter 22 "The Soldering of Pipe and Tube".
  - 4. Brazed Joints: Construct joints according to AWS "Brazing manual" in the "Pipe And Tube" chapter.
  - 5. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter.
    - a. Damaged Threads: Do not use pipe or fittings having threads that are corroded or damaged.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators.
  7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
- B. Grooved Pipe and Grooved Pipe Fitting Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved copper system shall be direct grooved CTS tube sized coupling and fittings.
  - C. Cast Iron Soil Pipe and Cast Iron Soil Pipe Fitting Joints: Make joints according to recommendations in CISPI 1990 revised and edited edition of "Cast Iron Soil Pipe and Fittings Handbook, Volume I", Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings".
    1. Compression Joint: Make with neoprene gasket matching class of pipe and fittings.
    2. Hubless Joint: Make with neoprene gasket and sleeve or clamp.
  - D. ABS DWV Pipe: Join ABS drainage pipe and fittings according to ASTM D 2661.
  - E. PVC DWV Pipe: Join PVC drainage pipe and fittings according to ASTM D 2665.
  - F. ABS to PVC Transition Joints: Make nonpressure transition joint between ABS and PVC drainage components, using fittings, solvent cements, and procedure conforming to ASTM D 3138.
  - G. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings with solvent cements.
  - H. Mechanically Formed Tee Fittings for Copper Pipe:
    1. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole with equipment specifically designed for this application (such as T-Drill Industries, Inc.) and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the branch tube wall so as to comply with the American Welding Society lap joint weld. The collaring device shall be fully adjustable as to insure proper tolerance and complete uniformity of the joint.
    2. The branch tube shall be notched to conform with the inner curve of the run tube and have two dimple/depth stops (one ¼" atop the other) to ensure penetration of the branch tube into the collar is of sufficient depth from brazing and that the branch tube does not obstruct the flow in the main line tube. Dimple/depth stops will be in line with the run of the tube. The second dimple will be ¼" above the first and will serve as a visual point of inspection.
    3. All joints for mechanically formed tee fittings shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using BcuP series filler metal. Note: Soft soldered joints will not be permitted. The installing Contractor shall assume responsibility for joints being installed in accordance with code and manufacturer's recommendation.
    4. All mechanically formed branch collars shall be listed by the National Standard Plumbing Code, I.A.P.M.O., S.B.C.C., HUD, U.S. Army Corps of Engineers, NAVFAC, and Underwriter's Laboratory. They shall also comply with the ASME Code for Pressure Piping ANSI B31.5c.

5. Before proceeding with mechanically formed tee fittings for copper pipe, the Contractor must submit what personnel they plan on having on site performing this type of installation with documentation that his personnel has been trained by the manufacturer for this product and in the proper installation procedures. Non-manufacturer trained personnel will not be acceptable for this installation and will not be allowed to perform this type of installation on this project.

### **3.8 INSTALLATION OF VALVES**

- A. Sectional Valves: Install sectional valves close to main on each branch and riser serving two or more plumbing fixtures or equipment connections and where indicated. Unless otherwise indicated on drawings, use ball valves for sectional valves 2 inches and smaller. Use butterfly valves for sectional valves 2-1/2 inches and larger.
- B. Shutoff Valves: Install shutoff valves on inlet to each plumbing equipment item, on each supply to each plumbing fixture not having stops on supplies, and elsewhere as indicated. Unless otherwise indicated on drawings, for shutoff valves 2 inches and smaller, use ball valves; for shutoff valves 2-1/2 inches and larger, use butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item located to drain equipment for service and repair. Install drain valve at base of each riser, at low points of horizontal runs, and where required to drain water distribution piping system.

### **3.9 CONNECTIONS**

- A. Supply Runouts to Fixtures: Install hot- and cold-water supply piping runouts of sizes indicated, but not smaller than required by plumbing code to fixtures.
- B. Drainage Runouts to Fixtures: Provide drainage and vent piping runouts, with approved trap, of sizes indicated, but not smaller than required by plumbing code, to plumbing fixtures and drains.
- C. Locate drainage piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.
- D. Mechanical Equipment Connections: Connect hot- and cold-water supply piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. Use flanges instead of unions for connections 2-1/2 inches and larger.
- E. Connect drainage and vent piping to the following:
  1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures".
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### **3.10 FIELD QUALITY CONTROL**

- A. Inspect Water Distribution Piping as Follows:
  1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.

2. During progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to time inspection must be made. Perform tests specified below in presence of the plumbing official.
  3. Roughing-In Inspection: Arrange for inspection of piping system before concealed or closed-in after system roughing-in and prior to setting fixtures.
  4. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
  5. Reinspections: When a plumbing official finds that piping system will not pass test or inspection, make required corrections and arrange for reinspection by the plumbing official.
  6. Reports: Prepare inspection reports signed by plumbing official.
- B. Test Water Distribution Piping as Follows:
1. Test for leaks and defects in new water distribution piping systems and parts of existing systems 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 system tested.
  2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
  3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
  5. Prepare reports for tests and required corrective action.
- C. Inspect Drainage Piping as Follows:
1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
  2. During progress of installation, notify the plumbing official having jurisdiction at least 24 hours prior to time such inspection must be made. Perform tests specified below in presence of the plumbing official.
    - a. Roughing-In Inspection: Arrange for inspection of piping system after system roughing-in, before concealing, and prior to setting fixtures.
    - b. Final Inspection: Arrange for final inspection by plumbing official to observe tests specified below and to ensure compliance with requirements of plumbing code.
  3. Reinspections: Make required corrections and arrange for reinspection by plumbing official when piping system fails to pass test or inspection.
  4. Reports: Prepare inspection reports signed by the plumbing official.
- D. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures of authority having jurisdiction or, in absence of published procedure, as follows:
1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
  2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for

testing work that has been covered or concealed before it has been tested and approved.

3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet of head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1 inch water column. Use a U tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### **3.11 CLEANING**

- A. Clean and disinfect water distribution piping as follows:
  1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.
  2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C651 or AWWA C652 or as described below:
  3. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  4. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate valve and allow to stand for 24 hours.
  5. Drain system or part thereof of previous solution and refill with water/chlorine solution contain at least 200 parts per million of chlorine. Isolate and allow to stand for three hours.
  6. Flush system with clean, potable water until chlorine does not remain in water coming from system following allowed standing time.
  7. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by the authority shows evidence of contamination.
- B. Prepare and submit reports for purging and disinfecting activities.
- C. Clean interior of piping system. Remove dirt and debris as work progresses.

### **3.12 COMMISSIONING**

- A. Fill water systems. Check that system is completely full of water.
- B. Before operating systems, perform these steps:
  1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to full open position.
  3. Open throttling valves to proper setting.

4. Remove plugs used during testing of piping systems and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

**3.13 PROTECTION**

- A. Place plugs in ends of uncompleted piping at end of day or when work stops.
- B. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with two coats of a water-based latex paint.

**END OF SECTION 22 1120**



**SECTION 22 1123.21  
INLINE, DOMESTIC-WATER 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, seal-less centrifugal pumps.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include construction materials, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, 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. Structural members to which pumps will be attached.
  - 2. Size and location of initial access modules for acoustical tile.
- B. Field quality-control reports.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Hydraulic Institute Compliance: Design, manufacture and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- 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. UL Compliance: UL 778 for motor-operated water pumps.
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- E. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For inline, domestic-water pumps to include in operation and maintenance manuals.

**1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

- C. Comply with pump manufacturer's written instructions for handling.

## **PART 2 - PRODUCTS**

### **2.1 IN-LINE, SEAL-LESS CENTRIFUGAL PUMPS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Taco.
  - 2. Bell & Gossett, ITT.
  - 3. Watts.
- B. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, seal-less, overhung-impeller centrifugal pumps.
- C. Pump Construction:
  - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
  - 2. Minimum Working Pressure: 125 psig.
  - 3. Maximum Continuous Operating Temperature: 220 deg F.
  - 4. Casing: Bronze or Stainless steel, with threaded or companion-flange connections.
  - 5. Impeller: Plastic, composite or stainless steel.
  - 6. Motor: Single speed.

### **2.2 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in for domestic-water-piping system to verify actual locations of piping connections before pump installation.

### **3.2 PUMP INSTALLATION**

- A. Comply with HI 1.4.
- B. Mount pumps in orientation complying with manufacturer's written instructions.
- C. Pump Mounting:
  - 1. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Install continuous-thread hanger rods and vibration isolation of size required to support pump weight.
  - 1. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

### 3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221120 "Plumbing Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to inline, domestic-water pumps, allow space for service and maintenance.
- C. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in the following:
  - 1. Section 220523 "Valves for Plumbing Piping."
  - 2. Install pressure gauge and snubber at suction of each pump and pressure gauge and snubber at discharge of each pump. Install at integral pressure-gauge taps where provided or install pressure-gauge connectors in suction and discharge piping around pumps. Comply with requirements for pressure gauges and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

### 3.4 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" for identification of pumps.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

### 3.6 STARTUP SERVICE

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping connections for tightness.
  - 3. Clean strainers on suction piping.
  - 4. Perform the following startup checks for each pump before starting:
    - a. Verify bearing lubrication.
    - b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    - c. Verify that pump is rotating in the correct direction.
  - 5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
  - 6. Start motor.

7. Open discharge valve slowly.

### **3.7 ADJUSTING**

- A. Adjust inline, domestic-water pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**END OF SECTION 22 1123.21**

**SECTION 22 1429  
SUMP PUMPS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Submersible sump pumps.
  - 2. Sump-pump basins and basin covers.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting 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 PERFORMANCE REQUIREMENTS**

- A. Hydraulic Institute Compliance: Design, manufacture and install plumbing pumps in accordance with "Hydraulic Institute Standards."
- 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.
- D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.
- E. SSPMA Compliance: Test and rate sump and sewage pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with manufacturer's written instructions for handling.

## **PART 2 - PRODUCTS**

### **2.1 SUBMERSIBLE SUMP PUMPS**

- A. Submersible, Fixed-Position, Single-Seal Sump Pumps:
  - 1. Description: Factory-assembled and -tested sump-pump unit.
  - 2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
  - 3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
  - 4. Impeller: Statically and dynamically balanced, design for clear wastewater handling, and keyed and secured to shaft.
  - 5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
  - 6. Seal: Mechanical.
  - 7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
    - a. Motor Housing Fluid: Air or Oil.
  - 8. Sump Pump Manufacturers:
    - a. Hydromatic
    - b. Little Giant (Elevator sump only or approved equal)
    - c. Weil
    - d. Liberty Pumps
  - 9. Controls:
    - a. Enclosure: NEMA 250, Type 1 (indoor)
    - b. Switch Type: Mechanical-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
    - c. Automatic Alternator for Duplex Pump Units: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    - d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float switch matching control and electric bell; 120 V ac, with transformer and contacts for remote alarm bell.
  - 10. Control-Interface Features:
    - a. Remote Alarm Contacts: For remote alarm interface.
    - b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:
      - 1) On-off status of pump.
      - 2) Alarm status.
  - 11. Capacities and Characteristics – See Drawings for Schedules.

### **2.2 SUMP-PUMP BASINS AND BASIN COVERS**

- A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.
  - 1. Material: Fiberglass or Polyethylene.
  - 2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
  - 3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.
- B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
  - 1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.
- C. Capacities and Characteristics: See Schedules on Drawings.

### **2.3 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Motors for submersible pumps shall be hermetically sealed.

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Excavation and filling are specified in Section 312000 "Earth Moving."

### **3.2 EXAMINATION**

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

### **3.3 INSTALLATION**

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.
- B. Sump pumps installed in pits subject to debris and trash accumulation shall be installed in a manner to minimize clogging.

### **3.4 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

### **3.5 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
  - 1. Perform each visual and mechanical inspection.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.6 STARTUP SERVICE**

- A. Perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

**3.7 ADJUSTING**

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

**3.8 DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

**END OF SECTION 22 1429**



**SECTION 223300  
ELECTRIC, DOMESTIC-WATER HEATERS**

**PART 1 -GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Commercial, electric, storage, domestic-water heaters.
  - 2. Domestic-water heater accessories.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include diagrams for power, signal, and control wiring.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.
- B. Product Certificates: For each type of electric, domestic-water heater.
- C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For special warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

**1.6 COORDINATION**

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

**1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including storage tank and supports.
    - b. Faulty operation of controls.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
  - 2. Warranty Periods: From date of Substantial Completion.
    - a. Electric, Storage, Domestic-Water Heaters:

- 1) Storage Tank: Three years.
- 2) Controls and Other Components: Two 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: Applicable requirements in ASHRAE/IES 90.1.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

### **2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS**

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
  1. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
  2. Standard: UL 1453.
  3. Storage-Tank Construction: ASME-code, steel vertical arrangement.
    - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
      - 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
    - b. Pressure Rating: 150 psig
    - c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.
  4. Factory-Installed, Storage-Tank Appurtenances:
    - a. Anode Rod: Replaceable magnesium.
    - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
    - c. Insulation: Comply with ASHRAE/IES 90.1.
    - d. Jacket: Steel with enameled finish or high-impact composite material.
    - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
    - f. Temperature Control: Adjustable thermostat.
    - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
    - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

### **2.3 DOMESTIC-WATER HEATER ACCESSORIES**

- A. Domestic-Water Expansion Tanks:
  1. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
  2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
  3. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
  - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
  - c. Air-Charging Valve: Factory installed.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.
- C. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE/IES 90.1.
- D. Heat-Trap Fittings: ASHRAE/IES 90.1.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base.
  - 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
  - 2. Maintain manufacturer's recommended clearances.
  - 3. Arrange units so controls and devices that require servicing are accessible.
  - 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 8. Anchor domestic-water heaters to substrate.
- B. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. 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.
- C. Install combination temperature-and-pressure relief valves in water piping for electric, 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.

- D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains.
- E. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters.
- F. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- G. Fill electric, domestic-water heaters with water.
- H. Charge domestic-water expansion tanks with air to required system pressure.
- I. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

### **3.2 PIPING CONNECTIONS**

- A. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

### **3.3 IDENTIFICATION**

- A. Identify system components.

### **3.4 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative]
- D. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, domestic-water heaters. Training shall be a minimum of one hours.

**END OF SECTION 223300**

**SECTION 22 4000  
PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets.
  - 2. Flushometers.
  - 3. Toilet seats.
  - 4. Protective shielding guards.
  - 5. Fixture supports.
  - 6. Water closets.
  - 7. Urinals.
  - 8. Lavatories.
  - 9. Miscellaneous fittings (except faucets).
- B. Related Sections include the following:
  - 1. Division 22 Section "Common Work Results for Plumbing".

**1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

**1.4 SUBMITTALS**

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

## 1.5 QUALITY ASSURANCE

- A. 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"; for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. To comply with "Reduction of Lead in Drinking Water Act" all pipe, fixtures, and fitting used to convey water for potable use shall contain less than 0.25% of lead by weight.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
  - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
  - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
  - 4. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
  - 5. Toilet Seats: Equal to 5 percent of amount of each type installed.

## PART 2 - PRODUCTS

### 2.1 LAVATORY FAUCETS

- A. Sink/Lavatory Faucets:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Standard Companies, Inc.
    - b. Chicago Faucets.
    - c. Kohler Co.
    - d. Moen Commercial.
    - e. Zurn Plumbing Products Group; Commercial Brass Operation.
    - f. Sloan Valve Company.
  - 2. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Provide with aerator device in non healthcare facilities. In healthcare facilities including nursing homes, provide laminar flow device having agion antimicrobial product protection.
    - a. Body Material: Commercial, solid brass.
    - b. Finish: Polished chrome plate.
    - c. Maximum Flow Rate: 2.2 gpm @ 60 psi – Private Lavatory
    - d. Maximum Flow Rate: 0.5 gpm @ 60 psi – Public Lavatory

- e. Maximum Flow Rate: 2.2 gpm @ 60 psi – Sink

## 2.2 FLUSHOMETERS

- A. Flushometers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products the following:
    - a. Sloan Valve Company.
  - 2. Description: Include brass body with corrosion-resistant internal components control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts. Flushometers shall be hardwired.

## 2.3 TOILET SEATS

- A. Toilet Seats:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Bemis Manufacturing Company.
    - b. Centoco Manufacturing Corp.
    - c. Church Seats.
    - d. Comfort Seats, Inc.
    - e. Kohler Co.
    - f. Olsonite Corp.
    - g. Sanderson Plumbing Products, Inc.; Beneke Div.
  - 2. Description: Toilet seat for water-closet-type fixture.

## 2.4 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. McGuire Manufacturing Co., Inc.
    - b. Plumberex Specialty Products Inc.
    - c. ProFlo
    - d. TCI Products.
    - e. TRUEBRO, Inc.
    - f. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
  - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. TRUEBRO, Inc.
    - b. PlumberEx Specialty Products, Inc.
  - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements and ASTM E84.

## 2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Josam Company.

2. MIFAB Manufacturing Inc.
  3. Smith, Jay R. Mfg. Co.
  4. Tyler Pipe; Wade Div.
  5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
1. Description: Extra heavy duty combination carrier designed for mounting height of wall-mounting, water-closet-type fixture. Carrier is to have a minimum rating of at least 500lbs. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
1. Description: Urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
  2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
1. Description: Lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
  2. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
1. Description: Sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

## 2.6 WATER CLOSETS

- A. Water Closets:
1. Manufacturers: Wall mounted water closets are to have at a minimum 500lbs load rating. Subject to compliance with requirements, provide products the following:
    - a. American Standard Companies, Inc.

## 2.7 URINALS

- A. Urinals:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. American Standard Companies, Inc.
  2. Description: Back-outlet, vitreous-china fixture designed for flushometer valve operation.

## 2.8 LAVATORIES

- A. Lavatories:
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. American Standard Companies, Inc.

## 2.9 STAINLESS-STEEL SINKS

- A. Stainless-Steel Sinks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Advance Tabco.
- b. Elkay Manufacturing Co.
- c. Just Manufacturing Company.

## 2.10 FITTINGS, EXCEPT FAUCETS

- A. Miscellaneous Fittings (Except Faucets):
  - 1. Central Brass Manufacturing Co.
  - 2. Chicago Faucet co.
  - 3. Crane Plumbing/ Fiat Products
  - 4. EBC
  - 5. Kohler Co.
- B. Fittings General: Unless otherwise specified, provide fittings fabricated of brass, with a polished chrome plated finish.
- C. Supply and drain plumbing service fittings shall be as specified and as scheduled.
- D. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
- E. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.
- F. Deep Pattern Escutcheons: Chrome-plated sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.
- G. Provide fittings specified as part of a fixture description, in lieu of fitting requirements above.
- H. Plumbing Fixture Insulation: Provide molded insulating system for exposed water supply and waste piping under handicap lavatories in accordance with ADA Accessibility Guideline 4.19.4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. For flexible water supply piping, install at proper length as to not leave excess piping.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General Duty Valves and Strainers."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- K. 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.
- L. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- M. Install toilet seats on water closets.
- N. 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.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install traps on fixture outlets.
  1. Exception: Omit trap on fixtures with integral traps.
  2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- T. Provide undercounter, ASSE 1070 compliant water temperature limiting device for all public hand washing facilities and bidets. Maximum allowable water temperature is 110°.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

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

- F. For hard wired sensor-operated faucets and flush valves, install faucet and flush valve and associated low voltage wiring with transformer and connect into 120 volt circuit terminated within junction box.

### **3.5 ADJUSTING**

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

### **3.6 CLEANING**

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

### **3.7 PROTECTION**

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

**END OF SECTION 22 4000**

**SECTION 23 0500  
COMMON WORK RESULTS FOR HVAC**

**PART 1 - GENERAL**

**1.1 GENERAL REFERENCE**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.
- B. Refer to Division 1 section "Alternates" for possible alternates affecting the extent of this Section of work.
- C. This Contractor is also referred to the Plumbing, Fire Protection, Civil, Architectural, Structural, Electrical and all other drawings and specifications pertinent to this project. All of the above mentioned drawings and specifications are considered a part of the Contract Documents.
- D. This section specifies the basic requirements for HVAC installations and includes requirements common to more than one section of Division 23. It expands and supplements the requirements specified in sections of Division 01.

**1.2 DEFINITIONS**

- A. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 23 shall be defined as the prime contractor who is responsible for the work specified, or indicated. The mechanical prime contracts for this project shall include the following:

<u>Prime Contract</u>	<u>Specification Sections</u>	<u>Drawings</u>
HVAC	Division 23	HVAC

- B. Throughout this specification section the term "Design Professional" is referenced. The specification calls for certain actions to be undertaken or referred to the Design Professional. Accordingly, the term "Design Professional" shall be defined as the firm with which the "Owner" has contracted to produce the contract drawings and specifications. It shall be understood that the Design Professional for this project is the Architect whose name is shown on the drawing title block.

**1.3 HVAC COORDINATION**

- A. This Contractor shall familiarize himself with the work to be done under other Divisions of this specification and their related drawings and shall so coordinate and schedule his work as not to cause delays or interference with the work of others. Such coordination and scheduling shall accomplish the installation of equipment and piping with a minimum of cutting through masonry and other adjustments.
- B. Ceiling grid systems shall not be supported from ductwork, heating or plumbing lines or any other utility lines, and vice versa. Each utility and the ceiling grid system shall be a separate installation and each shall be independently supported from the building structure-concrete, steel or masonry. Where interferences occur, in order to support ductwork, piping, ceiling grid systems, etc., trapeze type hangers or supports shall be employed which shall be located so as not to interfere with access to such mechanical equipment as valves, regulators, VAV or reheat terminals, fire dampers, etc.
- C. This Contractor shall be responsible for proper size and location of anchors, chases, recesses, openings, etc., required for the proper installation of his work. Verify all dimensions by field measurements. Coordinate the installation of required supporting

devices and sleeves in structural components as they are constructed. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work.

- D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. Extend all grease fittings to an accessible location. Install equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with a minimum of interference with other installations.
- E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- F. Specific divisions of responsibility when coordinating with trades other than mechanical shall be as indicated on drawings, in Division 1, and as follows:
  - 1. The HVAC Contractor shall provide and place all sleeves in floors, walls, etc., and coordinate such location.
  - 2. The HVAC Contractor shall rough-in and connect all equipment furnished by other trades or Owner where shown on the drawings.
  - 3. The HVAC Contractor shall provide motors, special controls, transformers and relays as required for the proper operation of all equipment furnished by him under this Division.

#### **1.4 EXAMINATION OF SITE**

- A. Before submitting a bid, the Contractor is requested to visit the job site to familiarize himself with construction conditions. No consideration or remuneration will be given for his failure to do so.

#### **1.5 DIVISION 23 DESIGN DOCUMENTS**

- A. Should it appear that there is a duplication on the Drawings or in the Specifications, wherein the same work or items are shown or specified as being provided under different contracts, subcontracts or supply orders, and such duplication is not clarified by Addendum during the bidding period, it shall be assumed that the prime contractors have included duplicate quotations in their proposal to the Owner. The Design Professional shall have the option of selecting the contract, subcontract or supply order under which the work or items are to be provided and a credit shall be due the Owner for the duplicate work or items.
- B. Where a discrepancy exists within the specifications, among the drawings, or between the specifications and the drawings, refer to project supplementary conditions.
- C. Should it appear that there is a duplication on the drawings or in the specifications, wherein the same work or items are shown or specified as being provided under separate subcontracts or supply orders, and such duplication is not clarified by addendum during the bidding period, it shall be assumed that the responsible prime contractor will select and coordinate which subcontract will supply the item and the item will be supplied as indicated. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on HVAC plans and Division 23 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all applicable mechanical work in his bid.

- D. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, piping and ductwork unless dimensions are given. Drawings are not to be scaled.
  - 1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instructions.
    - a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.
    - b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.
  - 2. Piping and ductwork are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional offset and fittings shall be provided as necessary to meet space constraints and to facilitate the work of other trades.
    - a. Recognizing the potential need for additional offsets and fittings in piping and ductwork, the Engineer has included a safety factor in all friction calculations. The Contractor is advised to plan and coordinate his work carefully to minimize the need for additional offsets and fittings. The Contractor shall be responsible to notify the Engineer of any and all modifications to systems which may affect the ability of equipment to serve its intended use prior to the purchase and installation of such equipment.
- E. All equipment, piping and material specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.
- F. If this Contractor proposes to install equipment requiring space conditions other than those as specified and/or shown on the design drawings, or to rearrange the equipment, he shall assume full responsibility for the rearrangement of the space and shall obtain the full approval of the Design Professional before proceeding with the work.

## 1.6 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements of this division, and in Division 1.
- B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of prints. Changes shall be accurately dimensioned and/or drawn to scale.
- C. This Contractor shall keep an updated set of specifications and prints, including changes on the job site, at all times and shall submit one (1) set of updated and legible prints to the Design Professional when the work is complete.

## 1.7 COORDINATION DRAWINGS

- A. Before construction work commences, Contractors for all trades shall submit coordination drawings in AutoCad drawn to scale for review. Such drawings will be required throughout all areas for all trades. The requirements for Coordination Drawings are specified in Division 23 and are reprinted below:
  - 1. The HVAC Contractor shall prepare the base plan coordination drawings showing all ductwork, all pertinent heating piping and equipment. The drawings shall be coordinated with lighting fixtures, sprinklers, air diffusers, other ceiling mounted items, ceiling heights, structural work, maintenance clearances, electric code clearances, reflected ceiling plans, and other contract requirements. Reposition proposed locations of work after coordination drawing review by the Architect and Engineer. Provide adjustments to exact size, location and offsets of ducts, pipes,

- conduit, etc., to achieve reasonable appearance objectives. Provide these adjustments as part of contract. Minor revisions need not be redrawn.
2. HVAC Contractor shall provide the base plan in AutoCad and submit the base plan to all major trades' Contractors. All ductwork and piping shall be on separate layers.
  3. The Fire Protection Contractor shall draft location of piping, sprinkler heads and equipment on the base plan using a separate layer, indicating areas of conflict and suggested resolutions.
  4. The Plumbing Contractor shall draft location of all piping and equipment on the base plan using a separate layer.
  5. The Electrical Contractor shall draft location of lighting fixtures, cable trays, and feeders over 2 in. on the base plan using a separate layer, indicating areas of conflict and suggested resolution.
  6. The HVAC Contractor shall then combine all layers on a composite AutoCad drawing indicating all areas of conflict.
  7. The General Trades Contractor shall indicate areas of architectural/structural conflicts or obstacles and coordinate to suit the overall construction schedule.
  8. The Construction Manager shall expedite all drawing work and coordinate to suit the overall construction schedule. He shall then review these drawings and compare them with the architectural, structural, equipment and other drawings and determine that all of the work can be installed without interference. In the case of unresolved interferences, he shall notify the Architect. The Architect will then direct the various Contractors as to how to revise their drawings as required to eliminate installation interferences.
  9. If a given trade proceeds prior to resolving conflicts, then, if necessary, that trade shall change its work at no extra cost in order to permit others to proceed with a coordinated installation. Coordination approval will be given for individual areas after special site meetings involving all Trades.
  10. Coordination drawings are intended for the respective Contractor's use during construction and shall not replace any Shop Drawings, or record drawings required elsewhere in these contract documents.
  11. After resolution of all conflicts, all trades shall sign and date a hard copy of the composite coordination drawing.

## 1.8 SHOP DRAWINGS

- A. Refer to the conditions of the Contract (General and Supplementary) and Division 01 Section: Shop drawings, product data, and samples for submittal definitions, requirements, and procedures.
- B. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information required by the contract documents. Shop drawings not stamped with Contractor approval will be returned for reprocessing.
  1. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.
  2. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.
  3. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.
  4. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be

supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.

- C. In checking shop drawings, the Design Professional will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.

## **1.9 EQUIPMENT**

- A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that the manufacturer of all parts of the equipment offered have been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.
- B. When two or more items of same equipment are required (pumps, valves, etc.) they shall be of the same manufacturer.
- C. In placing his bid, the Contractors under this Division shall take note that manufacturer's products change frequently, and only the scheduled products have been checked by the Engineer for compliance with the Contract Documents and physical characteristics. Other manufacturers are listed because they are believed to be capable of complying, and in order to achieve fair and competitive bidding. However, it is the responsibility of the manufacturer in his relationship with the Contractor to bid to the Contractor only products complying with the Contract Documents, and the responsibility of the Contractor to base his bid only on manufacturers which do comply. No consideration will be given to the Contractor for his failure to do this. Should Contractors during the bidding process discover that listed manufacturers cannot comply with the Documents, they are encouraged to contact the Engineer as soon as practical, and provided sufficient time in the bidding process exists, and the Engineer agrees with the request, the Engineer will attempt to adjust the documents in the addendum process. If no addendum is issued adjusting the requirements so that all listed manufacturers can bid, the Contractor will be required to supply one of the listed manufacturers which comply with the Contract Document requirements.

## **1.10 SUBSTITUTIONS**

- A. Refer to the Instructions to Bidders and the related Division 01 sections for requirements in selecting products and requesting substitutions.

## **1.11 CODES AND PERMITS**

- A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.
- B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any requirements of specifications which are in excess of Code requirements and not in conflict therewith.
- C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for work performed by them in connection with provision of service connections required under this DIVISION of specifications. Deliver all certificates to Design Professional in duplicate.



### **1.12 INTERFERENCES**

- A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Design Professional may direct to permit completion of Architectural work in accordance with plans and specifications.
- B. Install additional offsets on piping or ductwork where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.
- C. Report any interferences between work under this division and that of any other Contractors to the Design Professional as soon as they are discovered. The Design Professional will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

### **1.13 SHOP AREAS AND MATERIAL STORAGE**

- A. No mechanical related trade is permitted to use as shop working area, any concrete slab that is to receive metallic waterproofing, asphalt tile, plastic tile, etc., except by express permission of the Design Professional.
- B. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

### **1.14 CLEAN-UP**

- A. Refer to the Division 01 for general requirements for project cleaning.
- B. Insofar as the HVAC work is concerned, at all times keep premises and building in neat and orderly condition, follow explicitly any instructions of Design Professional in regard to storing of materials, protective measures, cleaning-up of debris, etc.
- C. Upon completion of work, this Contractor shall thoroughly clean all apparatus furnished by him, pack all valves and thoroughly clean piping, ductwork and equipment removing all dirt, grease and oil.
- D. Air systems shall not be operated without filters. Upon completion of work replace all filters.

### **1.15 OPERATING AND MAINTENANCE**

- A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 23 specification sections in the proper operation of the mechanical equipment. He shall also supply the Owner with three (3) hardbound copies of an operation manual containing the following:
  - 1. Step-by-step procedures for start-up and shutdown for each system and piece of equipment.
  - 2. Performance data, curves, ratings.
  - 3. Wiring diagrams.
  - 4. Manufacturer's descriptive literature.
  - 5. Automatic controls with diagrams and written sequence of operation.
  - 6. Manufacturer's maintenance and service manuals.
  - 7. Spare parts and replacement parts list for each piece of equipment.

8. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
9. Final approved shop drawings.
10. Final approved balance reports.

#### **1.16 WARRANTIES**

- A. Refer to the Division 1 Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.
- B. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Design Professional, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 23 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

#### **1.17 TEMPORARY SERVICES**

- A. The Contractor under this division shall provide temporary services, i.e.: heat, cooling, ventilation or water as specified herein or in Division 01 "General Conditions" and "Special Conditions" portions of this specification.
- B. Permanent equipment may be used for temporary (construction period) services only as directed by the Design Professional. Any permanent equipment used, shall be maintained by this Contractor. Owner's warrantee period shall not begin until final acceptance of the completed system.
- C. Permanent air handling units may be used during the construction period for heating or "drying-out" the building, however, unit shall operate in 100% outside air mode, with filters installed at all return air grilles and registers in the building. Air handling filters shall be provided by the contractor and shall not count toward the initial or spare filter sets provided at project completion. Prior to utilizing air handling units in such a manner, the air handling unit manufacturer shall perform startup inspections to prevent damage to the equipment.

#### **1.18 PROTECTION OF WORK AND PROPERTY**

- A. The Contractor shall be responsible for safeguarding work, property and facilities against damage, both his own as well as others, with which he may come into contact in the performance of his work.
- B. Stored materials shall be protected against damage from weather. Pipe and duct openings shall be closed with caps or plugs during installation. All fixtures and equipment shall be covered and protected against injury. Any materials or equipment damaged at any stage in the construction shall be replaced or repaired, and at the final completion of all work shall be in a clean, unblemished condition.

#### **1.19 CUTTING AND PATCHING**

- A. Refer to the Division 01 Section: CUTTING AND PATCHING for general requirements for cutting and patching.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

- C. The contractor under this division shall perform cutting, fitting, and patching of building components and mechanical equipment and materials required to:
  - 1. Uncover Work to provide for installation of ill-timed Work;
  - 2. Remove and replace defective Work;
  - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
  - 4. Remove samples of installed Work as specified for testing;
  - 5. Install equipment and materials in existing structures;
  - 6. Upon written instructions from the Design Professional, uncover and restore Work to provide for Design Professional observation of concealed Work.
- D. See other sections of this specification for demolition requirements.
- E. Pipe holes in floors and walls shall be core drilled if not sleeved during construction.

**1.20 INTERRUPTION OF SERVICE**

- A. When work progress makes temporary shutdown of services unavoidable, shutdown shall be coordinated with and approved by Owner so as to cause minimum disruption to established operating routine. Arrange to work as necessary to re-establish service within shortest possible down time. In those instances where the length of time required for the service interruption is not acceptable to the Owner, unless otherwise indicated, furnish and install temporary connections as required to reduce the length of time of service interruption to an acceptable level.

**PART 2 - PRODUCTS (Not Applicable to this Section)**

**PART 3 - EXECUTION**

**3.1 TESTS AND ADJUSTMENTS**

- A. Upon completion of the erection of all equipment and all work specified herein and/or shown on approved drawings, or at such times as directed by the Design Professional, this Contractor shall start all apparatus, make necessary tests as directed and as specified herein and make complete adjustments of all items of equipment before acceptance by the Design Professional to whose representative this Contractor shall demonstrate (by performance) all of the various apparatus and equipment.
- B. This Contractor is referred to Section 230593 "Testing, Adjusting, and Balancing for HVAC" for additional information and requirements. Cooperate fully with the Balancing Contractor to achieve a successful balance. Any and all adjustments to equipment including fan sheave replacement shall be the responsibility of this Contractor. Required adjustments shall be made during the course of the balancing procedure; the final balance report must reflect the best possible performance of the systems.
- C. When the Contractor is ready to run capacity tests, he shall notify the Design Professional. When this notice is given, the Design Professional will assume that the Contractor has made preliminary tests and is satisfied that the plant will develop specified and guaranteed capacities. It will be the Contractor's responsibility to furnish any and all instruments required to obtain test data which shall include thermometers, electric meters, pressure gages, etc.
- D. Work under this division of the specifications shall not be considered complete until the Contractor has obtained required inspection, performance tests, made necessary adjustments and has submitted satisfactory evidence of compliance. The Design Professional or his representative will make spot checks to determine the accuracy and completeness of final adjustments. Should spot checks indicate more than a reasonable

deviation from design requirements, the Contractor shall repeat tests and adjustments to the satisfaction of the Design Professional.

- E. After or during one complete heating and cooling season, the HVAC Contractor shall make any minor adjustments that may be necessary to ensure uniform temperatures throughout the spaces.
- F. During the testing and balancing period, this Contractor shall maintain on the job a competent individual thoroughly familiar with all phases of air conditioning, including refrigeration, temperature control, air and water distribution, for as long a period as may be required to thoroughly adjust all of the systems and to demonstrate to the Design Professional that they are functioning properly.

### **3.2 PUNCLISTS**

- A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional.

**END OF SECTION 23 0500**

**SECTION 230513  
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

**1.3 COORDINATION**

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

**PART 2 - PRODUCTS**

**2.1 GENERAL MOTOR REQUIREMENTS**

- A. Comply with 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.

Code Letter Designation:

1. Motors 15HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

## **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:
  1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

## **2.5 SINGLE-PHASE MOTORS**

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 23 0513**

**SECTION 230529  
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Fiberglass pipe hangers.
  - 4. Metal framing systems.
  - 5. Fiberglass strut systems.
  - 6. Thermal-hanger shield inserts.
  - 7. Fastener systems.
  - 8. Pipe stands.
  - 9. Equipment supports.
- B. Related Sections:
  - 1. Section 233113 "Metal Ducts" for duct hangers and supports.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.

**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: Pregalvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel

### **2.2 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### **2.3 FIBERGLASS PIPE HANGERS**

- A. Clevis-Type, Fiberglass Pipe Hangers:
  - 1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
  - 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of stainless steel
- B. Strap-Type, Fiberglass Pipe Hangers:
  - 1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
  - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel

### **2.4 METAL FRAMING SYSTEMS**

- A. MFMA Manufacturer Metal Framing Systems:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.
  - 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with inturred lips.
  - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.



7. Metallic Coating: Electroplated zinc.
- B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International; a subsidiary of Mueller Water Products Inc.
    - b. Empire Industries, Inc.
    - c. ERICO International Corporation.
    - d. Haydon Corporation; H-Strut Division.
    - e. NIBCO INC.
    - f. PHD Manufacturing, Inc.
    - g. PHS Industries, Inc.
  2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
  3. Standard: Comply with MFMA-4.
  4. Channels: Continuous slotted steel channel with inturned lips.
  5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
  7. Coating: Zinc.

## 2.5 FIBERGLASS STRUT SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit.
  2. Champion Fiberglass, Inc.
  3. Cooper B-Line, Inc.
  4. SEASAFE, INC.; a Gibraltar Industries Company.
- B. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.
1. Channels: Continuous slotted fiberglass channel with inturned lips.
  2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

## 2.6 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 2. Base: Stainless steel.
  - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 2. Bases: One or more; plastic.
  - 3. Vertical Members: Two or more protective-coated-steel channels.
  - 4. Horizontal Member: Protective-coated-steel channel.
  - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.8 EQUIPMENT SUPPORTS

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

## 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- K. Install lateral bracing with pipe hangers and supports to prevent swaying.
- L. 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.
- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb
    - b. Medium (MSS Type 32): 1500 lb
    - c. Heavy (MSS Type 33): 3000 lb
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

**END OF SECTION 23 0529**

**SECTION 230593  
TESTING, ADJUSTING AND BALANCING FOR HVAC**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Balancing Air Systems: Exhaust Systems

**1.3 DEFINITIONS**

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

**1.5 QUALITY ASSURANCE**

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB.
- B. Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.



- C. TAB Report Forms: Use standard TAB contractor's forms approved by A/E.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

## 1.6 PROJECT CONDITIONS

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

## 1.7 COORDINATION

- A. Notice: Provide seven (7) days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on water distribution systems have been satisfactorily completed.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 TAB SPECIALISTS

Retain this article and list of contractors to limit Contractor's choice of TAB contractors; delete to allow Contractor to select any contractor meeting qualification requirements.

- A. Subject to compliance with requirements, engage one of the following:
  - 1. Fulton Air Balance
  - 2. Kahoe Air Balance
  - 3. Professional Balance Company

### 3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 23 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Com-

pare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### **3.3 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Automatic temperature-control systems are operational.
  - 3. Equipment and duct access doors are securely closed.
  - 4. Balance, smoke, and fire dampers are open.
  - 5. Isolating and balancing valves are open and control valves are operational.
  - 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 indicated conditions for system operations can be met.

### **3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.

- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

### 3.6 TOLERANCES

- A. Set HVAC system's air flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent

### 3.7 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.8 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing A/E.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB contractor.
  - 3. Project name.
  - 4. Project location.
  - 5. A/E's name and address.
  - 6. Contractor's name and address.
  - 7. Report date.
  - 8. Signature of TAB supervisor who certifies the report.
  - 9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 10. Summary of contents including the following:

- a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
11. Nomenclature sheets for each item of equipment.
  12. Data for terminal units, including manufacturer's name, type, size, and fittings.
  13. Notes to explain why certain final data in the body of reports vary from indicated values.
  14. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Settings for supply-air, static-pressure controller.
    - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Duct, outlet, and inlet sizes.
  3. Terminal units.
  4. Position of balancing devices.
- E. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
    - a. System identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and size.
    - e. Manufacturer's serial number.
    - f. Arrangement and class.
    - g. Sheave make, size in inches (mm), and bore.
    - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches (mm), and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
    - g. Number, make, and size of belts.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Suction static pressure in inches wg.
- F. Instrument Calibration Reports:
1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.9 INSPECTIONS

- A. Initial Inspection:
  - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
  - 2. Check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.
    - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
    - c. Verify that balancing devices are marked with final balance position.
    - d. Note deviations from the Contract Documents in the final report.
- B. Final Inspection:
  - 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner and A/E.
  - 2. The TAB contractor's test and balance A/E shall conduct the inspection.
  - 3. Owner and A/E shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
  - 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  - 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
  - 1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  - 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

### 3.10 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

**END OF SECTION 23 0593**

**SECTION 230713  
DUCT INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes insulating the following duct services:
  - 1. Concealed supply and return.
  - 2. Exposed supply.
- B. Related Sections:
  - 1. Section 233113 "Metal Ducts" for duct liners.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

**1.6 COORDINATION**

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, max.  $k=0.31$  at 75 F mean, up to 250 F, 0.75 PCF density minimum, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
  - 1. Products: Subject to compliance with requirements, provide one of 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.
- F. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612; Form A, Class 1, max.  $k=0.26$  at 75 F mean, up to 250 F, 3.0 PCF density minimum; Type 1B, max.  $k=0.47$  at 300 F mean, up to 850 F, 2.8 PCF density minimum; all without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

### 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, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries;
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50. Mon-Eco Industries, Inc.; 22-25.

## **2.3 VAPOR RETARDER MASTICS**

- A. Materials shall be compatible with insulation materials, jackets, and substrates..

## **2.4 SEALANTS**

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76. Eagle Bridges - Marathon Industries; 405.
    - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
    - c. Mon-Eco Industries, Inc.; 44-05.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg .
  - 5. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: White.

## **2.5 FACTORY-APPLIED JACKETS**

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  - 2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## **2.6 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Embossed aluminum sheets 0.04" thick, ready for shop or field cutting and forming to indicated sizes.
  - 1. Moisture Barrier: 1-mil-(0.025-mm-) thick, heat-bonded polyethylene and kraft paper.



## 2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 491 AWF FSK.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - c. Compac Corporation; 110 and 111.
    - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 6.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 488 AWF.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - c. Compac Corporation; 120.
    - d. Venture Tape; 3520 CW.
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.8 SECUREMENTS

- A. Bands:
  - 1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.020 inch thick, 3/4 inch wide.
  - 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.007 inch thick, 3/4 inch wide.
- B. Insulation Pins and Hangers:
  - 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated.
    - a. Holding capacity of 100 lbs. for direct pull perpendicular to the attached surface.

2. 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.
    - a. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.
  3. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  1. Install insulation continuously through hangers and around anchor attachments.
  2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

### 3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches) o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

- c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.7 DUCT INSULATION SCHEDULE, GENERAL

- A. Ducts Requiring Insulation:
  1. Concealed supply.

- B. Items Not Insulated:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums and casings.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Factory-insulated access panels and doors.
  - 8. Bathroom exhaust ductwork.

### **3.8 DUCT INSULATION SCHEDULE**

- A. Concealed, round, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- B. Concealed, rectangular, supply-air duct insulation shall be the following:
  - 1. Mineral-Fiber Blanket: 2 inches thick and 0.75-lb/cu. ft. nominal density.
- C. Exposed, supply duct insulation shall be the following:
  - 1. Double wall ductwork with interstitial insulation.

**END OF SECTION 23 0713**

**SECTION 232300  
REFRIGERANT PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes refrigerant piping used for air-conditioning applications.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Line Test Pressure for Refrigerant R-410A:
1. Suction Lines for Air-Conditioning Applications: 300 psig.
  2. Suction Lines for Heat-Pump Applications: 535 psig.
  3. Hot-Gas and Liquid Lines: 535 psig.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
1. Thermostatic expansion valves.
  2. Solenoid valves.
  3. Hot-gas bypass valves.
  4. Filter dryers.
  5. Strainers.
  6. Pressure-regulating valves.
- 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 relationships between piping and equipment.
1. Shop Drawing Scale: 1/4 inch equals 1 foot
  2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control test reports.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

**1.7 QUALITY ASSURANCE**

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."  
B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

## 1.8 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
  - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
  - 2. End Connections: Socket ends.
  - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch long assembly.
  - 4. Pressure Rating: Factory test at minimum 500 psig.
  - 5. Maximum Operating Temperature: 250 deg F.

### 2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
  - 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
  - 3. Operator: Rising stem and hand wheel.
  - 4. Seat: Nylon.
  - 5. End Connections: Socket, union, or flanged.
  - 6. Working Pressure Rating: 500 psig (3450 kPa).
  - 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- B. Packed-Angle Valves:
  - 1. Body and Bonnet: Forged brass or cast bronze.
  - 2. Packing: Molded stem, back seating, and replaceable under pressure.
  - 3. Operator: Rising stem.
  - 4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
  - 5. Seal Cap: Forged-brass or valox hex cap.
  - 6. End Connections: Socket, union, threaded, or flanged.
  - 7. Working Pressure Rating: 500 psig (3450 kPa).
  - 8. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Check Valves:
  - 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
  - 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
  - 3. Piston: Removable polytetrafluoroethylene seat.
  - 4. Closing Spring: Stainless steel.
  - 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
  - 6. End Connections: Socket, union, threaded, or flanged.
  - 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
  - 8. Working Pressure Rating: 500 psig (3450 kPa).
  - 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
  2. Core: Removable ball-type check valve with stainless-steel spring.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Copper spring.
  5. Working Pressure Rating: 500 psig (3450 kPa).
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
  2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  3. Seat: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter.
  6. Working Pressure Rating: 400 psig (2760 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
  8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
  2. Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Seat Disc: Polytetrafluoroethylene.
  4. End Connections: Threaded.
  5. Working Pressure Rating: 400 psig (2760 kPa).
  6. Maximum Operating Temperature: 240 deg F (116 deg C).
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
  5. Suction Temperature: 40 deg F (4.4 deg C).
  6. Reverse-flow option (for heat-pump applications).
  7. End Connections: Socket, flare, or threaded union.
  8. Working Pressure Rating: 450 psig (3100 kPa).
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
  2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
  3. Packing and Gaskets: Non-asbestos.
  4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
  5. Seat: Polytetrafluoroethylene.
  6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter.
  7. End Connections: Socket.
  8. Throttling Range: Maximum 5 psig (34 kPa).
  9. Working Pressure Rating: 500 psig (3450 kPa).
  10. Maximum Operating Temperature: 240 deg F (116 deg C).
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
  2. Screen: 100-mesh stainless steel.
  3. End Connections: Socket or flare.
  4. Working Pressure Rating: 500 psig (3450 kPa).
  5. Maximum Operating Temperature: 275 deg F (135 deg C).
- J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
  2. Drain Plug: Brass hex plug.
  3. Screen: 100-mesh monel.



4. End Connections: Socket or flare.
  5. Working Pressure Rating: 500 psig (3450 kPa).
  6. Maximum Operating Temperature: 275 deg F (135 deg C).
- K. Moisture/Liquid Indicators:
1. Body: Forged brass.
  2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
  3. Indicator: Color coded to show moisture content in ppm.
  4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
  5. End Connections: Socket or flare.
  6. Working Pressure Rating: 500 psig (3450 kPa).
  7. Maximum Operating Temperature: 240 deg F (116 deg C).
- L. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
  2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  3. End Connections: Socket.
  4. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
  5. Working Pressure Rating: 500 psig (3450 kPa).
  6. Maximum Operating Temperature: 240 deg F (116 deg C).
- M. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
  2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
  3. End Connections: Socket.
  4. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
  5. Working Pressure Rating: 500 psig (3450 kPa).
  6. Maximum Operating Temperature: 240 deg F (116 deg C).
- N. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
  2. End Connections: Socket or flare.
  3. Working Pressure Rating: 500 psig (3450 kPa).
  4. Maximum Operating Temperature: 275 deg F (135 deg C).
- O. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
  2. Comply with UL 207; listed and labeled by an NRTL.
  3. Body: Welded steel with corrosion-resistant coating.
  4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
  5. End Connections: Socket or threaded.
  6. Working Pressure Rating: 500 psig (3450 kPa).
  7. Maximum Operating Temperature: 275 deg F (135 deg C).
- P. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
  2. End Connections: Socket or threaded.
  3. Working Pressure Rating: 500 psig (3450 kPa).
  4. Maximum Operating Temperature: 275 deg F (135 deg C).

### 2.3 REFRIGERANTS

- 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. Atofina Chemicals, Inc.
  2. DuPont Company; Fluorochemicals Div.
  3. Honeywell, Inc.; Genetron Refrigerants.
  4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

### **PART 3 - EXECUTION**

#### **3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A**

- A. Liquid Lines and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
- B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

#### **3.2 VALVE AND SPECIALTY APPLICATIONS**

- A. Install valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
  1. Install valve so diaphragm case is warmer than bulb.
  2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
  3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
  1. Solenoid valves.
  2. Thermostatic expansion valves.
  3. Hot-gas bypass valves.
  4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

#### **3.3 PIPING INSTALLATION**

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.

- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Install refrigerant piping in protective conduit where installed belowground.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- N. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

### 3.4 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.
- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
  - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
  - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
  - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod 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.
- D. Support multifloor vertical runs at least at each floor.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Comply with ASME B31.5, Chapter VI.
  - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
  - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
    - a. Fill system with nitrogen to the required test pressure.
    - b. System shall maintain test pressure at the manifold gage throughout duration of test.
    - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

### 3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
  - 1. Install core in filter dryers after leak test but before evacuation.
  - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  - 4. Charge system with a new filter-dryer core in charging line.

### 3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  - 1. Open shutoff valves in condenser water circuit.
  - 2. Verify that compressor oil level is correct.
  - 3. Open compressor suction and discharge valves.
  - 4. Open refrigerant valves except bypass valves that are used for other purposes.
  - 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

**END OF SECTION 23 2300**

**SECTION 233113  
METAL DUCTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round ducts and fittings
  - 3. Sealants and gaskets.
  - 4. Hangers and supports.
- B. Related Sections:
  - 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.
- B. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Delegated-Design Submittal:
  1. Sheet metal thicknesses.
  2. Joint and seam construction and sealing.
  3. Reinforcement details and spacing.
  4. Materials, fabrication, assembly, and spacing of hangers and supports.

## **1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
  2. Suspended ceiling components.
  3. Structural members to which duct will be attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Penetrations of smoke barriers and fire-rated construction.
  6. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Perimeter moldings.
- B. Field quality-control reports.

## **PART 2 - PRODUCTS**

### **2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS**

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
    - f. <Insert manufacturer's name>.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. 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."
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 8. Service: Indoor or outdoor.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.



- D. Round Duct Joint O-Ring Seals:
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
  - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

### **3.2 DUCT SEALING**

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Conditioned Space, Exhaust Ducts: Seal Class B.

### **3.3 HANGER AND SUPPORT INSTALLATION**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- E. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### **3.4 CONNECTIONS**

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### **3.5 FIELD QUALITY CONTROL**

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak-proof performance.
- B. Seal all visible openings in ducts. Particularly at notches on rectangular duct joints. Seal air leaks audible at system operating conditions.

### **3.6 START UP**

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### **3.7 DUCT FABRICATION**

- A. General:

1. Factory fabricate or shop fabricate ductwork as indicated on the drawings and in schedules.
2. Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.
3. Shop fabricate ductwork of gages and reinforcement strictly complying with the latest edition of SMACNA "HVAC Duct Construction Standards", for pressure classification indicated on the drawings and in schedules. If not indicated elsewhere, ductwork shall be constructed to a minimum standard of 2 inch water column.
4. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1-1/2 times associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.
5. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.
6. Provide at Installer's option, a manufactured system complete with certified tests by manufacturer to show that rigidity and performance is equivalent to SMACNA and/or ASHRAE standard gauge ductwork.

**END OF SECTION 23 3113**

**SECTION 233300  
AIR DUCT ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Manual volume dampers.
  - 2. Flexible connectors.
  - 3. Duct accessory hardware.

**1.3 ACTION SUBMITTALS**

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
  - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

## 2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. 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 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. Flexmaster U.S.A., Inc.
    - d. McGill AirFlow LLC.
    - e. Nailor Industries Inc.
    - f. Pottorff.
    - g. Ruskin Company.
    - h. Trox USA Inc.
    - i. Vent Products Company, Inc.
  - 2. Standard leakage rating.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized-steel, 0.064 inch thick.
  - 6. Blade Axles: Galvanized steel.
  - 7. Bearings:
    - a. Oil-impregnated bronze.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  - 8. Tie Bars and Brackets: Galvanized steel.
- B. Damper Hardware:
  - 1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.

## 2.4 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Elgen Manufacturing.

4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  1. Minimum Weight: 26 oz./sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.

## **2.5 DUCT ACCESSORY HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  1. Install steel volume dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install flexible connectors to connect ducts to equipment.
- H. Install duct test holes where required for testing and balancing purposes.

### **3.2 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  1. Operate dampers to verify full range of movement.
  2. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 3300**

**SECTION 233423  
HVAC POWER VENTILATORS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Ceiling-mounted ventilators.

**1.3 PERFORMANCE REQUIREMENTS**

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
  - 1. Certified fan performance curves with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness and finishes, including color charts.
  - 5. Dampers, including housings, linkages, and operators.
  - 6. Roof curbs.
  - 7. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

## **1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

## **1.7 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

## **1.8 COORDINATION**

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## **PART 2 - PRODUCTS**

### **2.1 CEILING-MOUNTED VENTILATORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Broan-NuTone LLC.
  - 2. Greenheck Fan Corporation.
  - 3. Loren Cook Company.
- 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. Variable-Speed Controller: Solid-state control to allow balancing of fan.
  - 2. Isolation: Rubber-in-shear vibration isolators.
  - 3. Manufacturer's standard roof jack or wall cap, and transition fittings.

### **2.2 MOTORS**

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.



### **2.3 SOURCE QUALITY CONTROL**

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install power ventilators level and plumb.
- B. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch.
- C. Install units with clearances for service and maintenance.
- D. Label equipment with press on labels.

### **3.2 CONNECTIONS**

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
  - 5. Verify lubrication for bearings and other moving parts.
  - 6. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 7. Shut unit down and reconnect automatic temperature-control operators.
  - 8. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

### **3.4 ADJUSTING**

- A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- B. Lubricate bearings.

**END OF SECTION 23 3423**

**SECTION 233713  
DIFFUSERS, REGISTERS, AND GRILLES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Rectangular and square ceiling diffusers.
  - 2. Louver face diffusers.
- B. Related Sections:
  - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.

**PART 2 - PRODUCTS**

**2.1 CEILING DIFFUSERS**

- A. Rectangular and Square Ceiling Diffusers:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Price Industries
  - b. Krueger.
  - c. Titus.

- C. Louver Face Diffuser :
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Price Industries
    - a. Krueger.
    - b. Titus.

## 2.2 REGISTERS AND GRILLES

- A. Louver Face Grille:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - 1. Price Industries
    - a. Krueger.
    - b. Titus.

## 2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

**END OF SECTION 23 3713**

## **SECTION 23 5400 FURNACES**

### **PART 1 GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Electric furnaces and accessories complete with controls.
  - 2. Air filters.
  - 3. Refrigeration components.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each of the following:
  - 1. Furnace.
  - 2. Remote room sensors, central controllers.
  - 3. Air filter.
  - 4. Refrigeration components.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Warranty: Special warranty specified in this Section.

#### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For each furnace to include in emergency, operation, and maintenance manuals for each of the following:
  - 1. Furnace and accessories complete with controls.
  - 2. Air filter.
  - 3. Refrigeration components.

#### **1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Disposable Air Filters: Furnish two complete sets.

#### **1.7 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- D. Comply with NFPA 70.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components of furnaces that fail in materials or workmanship within specified warranty period:
  - 1. Warranty Period, Commencing on Date of Substantial Completion:
    - a. Furnace Heat Exchanger: Lifetime.
    - b. Refrigeration Compressors: 10 years.
    - c. Evaporator and Condenser Coils: Five years.

## PART 2 PRODUCTS

### 2.1 ELECTRIC FURNACES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amana Heating & Air Conditioning; Goodman Manufacturing Company, L.P.
  - 2. Armstrong Air Conditioning Inc.
  - 3. Bryant Heating & Cooling Systems; Div. of United Technologies Corp.
  - 4. Carrier Corporation; Div. of United Technologies Corp.
  - 5. Comfort-Aire; a division of Heat Controller, Inc.
  - 6. Comfortmaker Air Conditioning & Heating; a division of International Comfort Products, LLC.
  - 7. Eubank Manufacturing Enterprise, Inc.
  - 8. Lennox Industries Inc.
  - 9. Luxaire Corporation; a division of Unitary Products Group.
  - 10. Rheem Manufacturing Company; Air Conditioning Division.
  - 11. Ruud Air Conditioning Division.
  - 12. York International Corp.; a division of Unitary Products Group.
  - 13. Daikin Comfort Technologies Inc.
  - 14. Trane
- B. General Requirements for Electric Furnaces: Factory assembled, piped, wired, and tested.
- C. Cabinet: Steel, with duct liner downstream from cooling coil].
  - 1. Duct Liner: Fiberglass, minimum 1/2 inch thick, complying with ASTM C 1071 and having a coated surface exposed to airstream complying with NFPA 90A or NFPA 90B and with NAIMA's "Fibrous Glass Duct Liner Standard."
    - a. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
  - 2. Factory paint external cabinets in manufacturer's standard color.
- D. Fan: Centrifugal, factory balanced, resilient mounted, direct drive.
  - 1. Fan Motors: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 2. Special Motor Features: Single speed, Premium (TM) efficiency, as defined in Section 230513 "Common Motor Requirements for HVAC Equipment," and with internal thermal protection and permanent lubrication.
  - 3. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

4. Special Motor Features: Electronically controlled motor (ECM) controlled by integrated furnace/blower control.
- E. Electric-Resistant Heating Elements: Helix-wound, nickel-chromium wire-heating elements in ceramic insulators mounted on steel supports.
- F. Heating-Element Control: Sequencer relay with relay for each element; switches elements on and off, with delay between each increment; initiates, stops, or changes fan speed.
- G. Summer Fan Switch: Connected to permit independent on-off switch of unit fan.

## 2.2 THERMOSTATS

- A. Controls shall comply with requirements in ASHRAE/IESNA 90.1, "Controls."
- B. Solid-State Thermostat: Wall-mounting, programmable, microprocessor-based unit with [automatic] [manual] switching from heating to cooling, preferential rate control, seven-day programmability with minimum of four temperature presets per day, and battery backup protection against power failure for program settings.

## 2.3 AIR FILTERS

- A. Disposable Filters: 1-inch thick fiberglass media with ASHRAE 52.2 MERV rating of 6 or higher.

## 2.4 REFRIGERATION COMPONENTS

- A. General Refrigeration Component Requirements:
  1. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.
  2. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Standard for Buildings except Low-Rise Residential Buildings."
- B. Refrigerant Coil: Copper tubes mechanically expanded into aluminum fins. Comply with ARI 210/240, "Unitary Air-Conditioning and Air-Source Heat Pump Equipment." Match size with furnace. Include condensate drain pan with accessible drain outlet complying with ASHRAE 62.1.
  1. Refrigerant Coil Enclosure: Steel, matching furnace and evaporator coil, with access panel and flanges for integral mounting at or on furnace cabinet and galvanized sheet metal drain pan coated with black asphaltic base paint.
- C. Refrigerant Line Kits: Annealed-copper suction and liquid lines factory cleaned, dried, pressurized with nitrogen, sealed, and with suction line insulated. Provide in standard lengths for installation without joints, except at equipment connections.
  1. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I, 1/2 inch thick.
- D. Refrigerant Piping: Comply with requirements in Section 232300 "Refrigerant Piping."
- E. Air-Cooled, Compressor-Condenser Unit:
  1. Condensing unit to be capable of operation down to 0 deg F outside air temperature. Provide with integral outside air temperature sensor.
  2. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
  3. Compressor: Hermetically sealed scroll type.
    - a. Crankcase heater.
    - b. Vibration isolation mounts for compressor.
    - c. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
    - d. Two-speed compressor motors shall have manual-reset high-pressure switch and automatic-reset low-pressure switch.
  4. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

5. Fan: Aluminum-propeller type, directly connected to motor.
  6. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Zone Control Dampers & Damper control module
1. Provide two 45 degree control dampers and actuators per furnace. Control dampers to be sized to match the zone main duct size.
  2. Each furnace to be provided with a damper control module.
- G. Infinity Central controller and Smart Sensors
1. Provide in white
  2. 7-day programmable system.
  3. Auto heat/cool changeover.
  4. Airflow speed trimming adjustment.

## **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 factory-installed insulation before furnace installation. Reject units that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Base-Mounted Units: Secure units to substrate through vibration isolation pads.
- B. Controls: Install thermostats at mounting height of 60 inches above floor. Verify final height with Architect.
- C. Wiring Method: Install control wiring in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal control wiring except in unfinished spaces.
- D. Install ground-mounted, compressor-condenser components on reinforced concrete base.

### **3.3 CONNECTIONS**

- A. Install piping adjacent to equipment to allow service and maintenance.
  1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  3. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
    - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
    - b. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
    - c. Requirements for Low-Emitting Materials:
      - 1) CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      - 2) Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Connect ducts to furnace with flexible connector. Comply with requirements in Section 233300 "Air Duct Accessories."
- C. Connect refrigerant tubing kits to refrigerant coil in furnace and to air-cooled, compressor-condenser unit.
  1. Flared Joints: Use ASME B16.26 fitting and flared ends, following procedures in CDA's "Copper Tube Handbook."



2. 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.
  3. 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.
- D. Comply with requirements in Section 232300 "Refrigerant Piping" for installation and joint construction of refrigerant piping.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
1. Perform electrical test and visual and mechanical inspection.
  2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.
  4. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.
  5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

### **3.5 STARTUP SERVICE**

- A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
1. Inspect for physical damage to unit casings.
  2. Verify that access doors move freely and are weathertight.
  3. Clean units and inspect for construction debris.
  4. Verify that all bolts and screws are tight.
  5. Adjust vibration isolation and flexible connections.
  6. Verify that controls are connected and operational.
- B. Start unit according to manufacturer's written instructions and complete manufacturer's operational checklist.
- C. Measure and record airflows.
- D. Verify proper operation of capacity control device.
- E. After startup and performance test, lubricate bearings.

### **3.6 ADJUSTING**

- A. Adjust initial temperature and humidity set points.
- B. Set controls, burner, and other adjustments for optimum heating performance and efficiency. Adjust heat-distribution features, including shutters, dampers, and relays, to provide optimum heating performance and system efficiency.

### **3.7 CLEANING**

- A. After completing installation, clean furnaces internally according to manufacturer's written instructions.
- B. Install new filters in each furnace within 14 days after Substantial Completion.

### **3.8 DEMONSTRATION**

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

**END OF SECTION 23 5400**

**SECTION 23 8113.11**  
**PACKAGED TERMINAL AIR-CONDITIONERS, THROUGH-WALL 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, terminal, through-the-wall air conditioners.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For packaged, terminal air conditioners.
  - 1. Include plans, elevations, sections, details for wall penetrations, and attachments to other work.
  - 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.
- C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For packaged, terminal air conditioners, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Field quality-control reports.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For packaged, terminal air conditioners to include in emergency, operation, and maintenance manuals.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of packaged, terminal air conditioners that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than five years from date of Substantial Completion, including components and labor.
  - 2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than one year from date of Substantial Completion, including only components and excluding labor.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amana Heating and Air Conditioning
  - 2. Friedrich; a Rheem Company
  - 3. GE Appliances

**2.2 MANUFACTURED UNITS**

- A. Description: Factory-assembled and -tested, self-contained, packaged, terminal air conditioner with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis.

- 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- E. ASHRAE Thermal Comfort: Applicable requirements in ASHRAE 55.
- F. UL listed and ETL performance certified.

## **2.3 CHASSIS**

- A. Cabinet: 0.037-inch thick powder-coated steel with removable front panel with concealed latches.
  - 1. Mounting: Floor with subbase.
  - 2. Louvers: Extruded aluminum with anodized finish. Coordinate final color with architect / owner.
  - 3. Access Door: Hinged door in top of cabinet for access to controls.
  - 4. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
  - 5. Electrical Subbase: Enameled steel with four adjustable leveling feet and adjustable end plates.
  - 6. Wall Sleeves: Galvanized steel with powder-coated paint.
- B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor and hermetically sealed scroll compressor with vibration isolation and overload protection.
  - 1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins with capillary tube distributor on indoor coil.
  - 2. Accumulator.
  - 3. Constant-pressure expansion valve.
  - 4. Reversing valve.
  - 5. Charge: R-410A.
- C. Indoor Fan: Forward curved, centrifugal; with modulating speed motor and positive-pressure ventilation damper with electric operator.
- D. Filters: MERV 8 minimum.
- E. Condensate Drain: Drain pan to direct condensate to building exterior.

## **2.4 HEATING**

- A. Electric-Resistance Heating Coil: Nickel-chromium-wire, electric-resistance heating elements with contactor and high-temperature-limit switch.

## **2.5 CONTROLS**

- A. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage, adjustable thermostat with heat anticipator; heat-off-cool-auto switch; and on-auto fan switch.
- B. Outdoor Air: Motorized intake damper. Open intake when unit indoor-air fan runs.

## **2.6 SOURCE QUALITY CONTROL**

- A. Sound-Power Level Ratings: Factory test to comply with AHRI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."
- B. Unit Performance Ratings: Factory test to comply with AHRI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install wall sleeves in finished wall assembly; seal and weatherproof.

**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.
- B. After operational test, change filters.

**3.3 ADJUSTING**

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

**3.4 DEMONSTRATION**

- A. Owner's maintenance personnel to adjust, operate, and maintain packaged, terminal air conditioners.

**END OF SECTION 23 8113.11**

**SECTION 23 8119  
ENVIRONMENTAL 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. This Section includes the following types of environmental conditioning units:
  - 1. Split system DX units with electric reheat and humidifier.

**1.3 SUBMITTALS**

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For computer-room air-conditioning units to include in emergency, operation, and maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

**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. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- D. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."
- E. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

**1.5 COORDINATION**

- A. Coordinate layout and installation of environmental conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of computer-room air-conditioning units that fail in materials or workmanship within specified warranty period.
- B. Warranty Period for Compressors: Manufacturer's standard, but not less than 5 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers:
  - 1. Liebert

### **2.2 EVAPORATOR CABINET CONSTRUCTION**

- A. The cabinet and chassis shall be constructed of heavy gauge galvanized steel, and shall be serviceable from one side. Mounting brackets shall be factory-attached to the cabinet. Internal cabinet insulation shall meet ASHRAE 62.1 requirements for Mold Growth, Humidity & Erosion, tested per UL 181 & ASTM 1338 standards.

### **2.3 AIR DISTRIBUTION**

- A. The fan shall be the belt drive, centrifugal type, double width, double inlet. The shaft shall be heavy-duty steel with self-aligning ball bearings with minimum life of 100,000 hours. The fan motor shall be 1750 rpm and mounted on an adjustable base. The drive package shall be equipped with an adjustable motor pulley. The fan/motor assembly shall be mounted on vibration isolators.
- B. A blower box shall be field attached to the evaporator to provide up to 2.0" (51mm) of external static pressure on the discharge side of the evaporator. The blower box shall contain a centrifugal type, double inlet blower, with belt drive and single speed motor, mounted to an adjustable motor base.
- C. System shall be suitable for ducted air distribution.

### **2.4 MICROPROCESSOR CONTROL**

- A. The control system shall be microprocessor-based, factory-wired into the system and tested prior to shipment. The wall-mounted control enclosure shall include a 2-line by 16-character LCD providing continuous display of operating status and alarm condition. A 7-key membrane keypad for setpoint/program control and unit On/Off shall be located below the display. The control display shall be field-wired to the control board using 4-conductor field-supplied thermostat wire.
- B. Temperature and humidity sensors shall be located in the wallbox, which shall be capable of being located up to 300 ft (91.4m) from the evaporator unit.

### **2.5 ELECTRICAL**

- A. All electrical components including contactors, relays, control transformers, and capacitors shall be pre-wired. The control circuit voltage shall be 24 volts. A micro-switch shall disable the unit operation prior to condensation pan overflow should the drain line become plugged with debris.
- B. Provide units with disconnect switch. The disconnect switch with 1/4 turn latch shall be factory installed and wired. The switch must be in the "OFF" position to remove panel and access electrical compartment.
- C. Indoor split systems shall be provided with separate power feeds. A power connection shall be provided for both the evaporator section and/or condenser/condensing unit.

## 2.6 MONITORING

- A. The microprocessor shall be a wall mounted, one row, 16-character control that will monitor the controlled environment's humidity, air flow, and cleanliness, and provide alarm history and an automatic self-test of the microprocessor on system start-up. Multiple messages shall be displayed by automatically scrolling from each message to the next. All messages shall be presented in a clear vernacular format on the liquid crystal display (LCD). Multiple alarms shall be displayed sequentially in order of occurrence.
- B. The LCD display shall provide on/off indication, operating mode indication (cooling, heating, humidifying, dehumidifying) and current day, time, temperature and humidity indication. The monitoring system shall be capable of relaying unit operating parameters and alarms to the monitoring system.
- C. A slide switch shall allow unit on/off operation. Push buttons shall allow menu selection for programming, operational information, diagnostics, and historical data. A two-level password feature shall prevent unauthorized access. Menu programmed information for basic system operation and alarm parameters shall be non-volatile.
- D. Processor shall have an inclusive seven-day programming format for unoccupied or low demand periods. This secondary schedule shall minimize equipment runtimes, reducing energy consumption and provide user cost savings.

## 2.7 CONTROL SETPOINT PARAMETERS

- Temp. Setpoint 65-85°F (18 to 29°C)
- Temp. Sensitivity 1 to 9.9°F (1 to 5°C)
- Humidity Setpoint 20-80% RH
- Humidity Sensitivity 1 to 30% RH

## 2.8 UNIT CONTROLS

- A. Compressor Short-Cycle Control
  1. The control system shall prevent compressor short-cycling by a 3-minute timer from compressor stop to the next start.
- B. Common Alarm and Remote On/Off
  1. A common alarm relay shall be provided to provide a contact closure to a remote alarm device. Two (2) terminals shall also be provided for remote On/Off control. Individual alarms shall be "enabled" or "disabled" from reporting to the common alarm.
- C. Setback
  1. The control shall be user configurable to use a manual setpoint control or a programmable time-based setback control. The setback control will be based on a 5 day/2 day program weekly schedule with capability of accepting 2 events per program day.
- D. Sensor Calibration
  1. The control shall include the capabilities to calibrate the temperature and humidity sensors and adjust the sensor response delay time from 1 to 90 seconds.
- E. System Auto Restart
  1. For start-up after power failure, the system shall provide automatic restart with a programmable (up to 9.9 minutes in 6-second increments) time delay. Programming can be performed either at the wallmounted controller or from the central site monitoring system.

## 2.9 ALARMS

- A. Unit Alarm



1. The control system shall monitor unit operation and activate an audible and visual alarm in the event of the following factory preset alarm conditions:
  - High Temperature
  - Low Temperature
  - High Humidity
  - Low Humidity
  - High Water Alarm - Lockout Unit Operation
  - High Head Pressure
  - Loss of Power
  - Compressor Short Cycle
  - Humidifier Problem
  - Filter Clog
  - A/C condensate backup / trouble
- B. Alarm Controls
  1. Each alarm (unit and custom) shall be individually enabled or disabled (except for high head pressure and high water in condensate pan).
- C. Audible Alarm
  1. The audible alarm shall annunciate any alarm that is enabled by the operator.
- D. Common Alarm
  1. A programmable common alarm relay shall be provided to interface user selected alarms with a remote alarm device. Alarms shall be enabled or disabled from reporting to the common alarm.
  2. Provide dry set of contacts for tie into building automation system indicating alarm condition.

## **2.10 DIRECT EXPANSION SYSTEM EVAPORATOR COMPONENTS**

- A. The evaporator section shall include evaporator coil, thermostatic expansion valve and filter drier. An externally equalized thermostatic expansion valve shall control refrigerant flow. The evaporator coil shall be factory-charged with R-407C refrigerant and sealed. The evaporator unit can be coupled directly with the condensing unit or mounted remote to the condensing unit.
- B. The coil shall be provided with a stainless steel or aluminum drain pan, with an internally trapped drain line. The evaporator drain pan shall include a factory installed float switch to shutdown the evaporator upon high water condition.
- C. The refrigeration system shall be split type consisting of an evaporator section and a remote outdoor condensing unit. The evaporator and condensing unit shall be factory assembled and tested. Refrigeration piping and control wiring between the evaporator section and the condensing unit shall be field provided.
- D. Direct Expansion Coil
  1. The evaporator section shall include evaporator coil, thermostatic expansion valves, and filter driers.
- E. Outdoor Air-Cooled Prop Fan Condensing Unit
  1. Condensing unit components shall include a condenser coil, a direct-drive propeller-type fan, a scroll compressor, high pressure switch, Liebert Lee-Temp receiver and head pressure control valve, hot gas bypass system and liquid line solenoid valve. A hot gas bypass system shall be provided to reduce compressor cycling and improve operation under low load conditions.
  2. All components shall be factory-assembled, charged with R-407C refrigerant and sealed. No internal piping, brazing, dehydration or charging shall be required. Condensing unit shall be designed for 95°F (35°C) ambient and be capable of operation to -30°F (-34.4°C).
  3. The condenser coil shall be constructed of copper tubes and aluminum fins.
- F. Factory Installed Options

1. Steam Generating Humidifier
    - a. The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, steam distributor, and electronic controls. The need to change canister shall be annunciated on the microprocessor wallbox control panel. An LED light on the humidifier assembly shall indicate cylinder full, over-current detection, fill system fault, and end of cylinder life conditions.
  2. Electric Reheat
    - a. The electric reheat shall be low-watt density, 304/304 stainless steel, finned-tubular and shall be capable of maintaining room dry bulb conditions when the system is calling for dehumidification. The reheat section shall include an agency-approved safety switch to protect the system from overheating.
    - b. Provide unit with electric reheat. The reheat shall be of the finned enclosed sheath type, fabricated of stainless steel core sheath with pleated fins to withstand moist conditions. The reheat shall be installed on air discharge side of the evaporator.
  3. Disconnect Switch, Non-Locking
    - a. The non-automatic, non-locking, molded case circuit breaker shall be factory mounted in the high voltage section of the electrical panel. The switch shall be accessible from the front of the unit.
  4. Filter Clog
    - a. The filter clog switch shall activate the audible and visual alarm on the wallbox when filter pressure drop exceeds and adjustable setpoint.
  5. Unit shall be provided with a low ambient control damper. A damper section with head pressure operator shall enable unit to operate down to -30° F/-34.4° C. Damper section and control shall ship loose for field installation.
- G. Ship-Loose Accessories
1. Remote Sensors
    - a. The unit shall be supplied with remote temperature and humidity sensors.
  2. Air Filter Box
    - a. The evaporator section shall be supplied with an air filter box for use with ducted installations. Two (2) filters shall be included 4" x 20" x 20" (102 mm x 508mm x 508mm) each, pleated type, with a MERV 8 rating, based on ASHRAE 52.2. A duct flange shall be supplied for use on the supply air opening of the unit.
  3. Refrigerant Line Sweat Adapter Kit
    - a. Provide a sweat adapter kit to permit field brazing of refrigerant line connections.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install air conditioning unit in accordance with manufacturer's installation instructions. Install unit plumb and level, firmly anchored to support the unit's weight in location indicated and maintain manufacturer's recommended clearances. Do not mount units above sensitive electronic equipment to minimize risk of water overflow/leakage damage and improve maintenance/service access.
- B. Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.
- C. Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's piping connection diagram submittal to piping contractor.

- D. Connect water supply and drains to air conditioning unit. Unit drain shall be trapped internally and shall not be trapped externally.
- E. Install all ship loose accessories per manufacturers requirements.
- F. Install air-cooled condensing unit on outside roof equipment supports.

### **3.2 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Drainage Connections: Provide adequate connections for condensate drain.
- D. Electrical System Connections: Comply with applicable requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding."
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.3 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

### **3.4 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that room air-conditioning units are installed and connected according to manufacturer's written instructions and 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.
- E. After startup service and performance test, change filters and flush humidifier.

### **3.5 ADJUSTING**

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose, without additional cost.
- D. Manufacturer's service technician to adjust hot gas bypass at startup to match load.

### **3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain environmental conditioning units. Refer to Division 1 Section "Closeout Procedures".

**END OF SECTION 23 8119**

**SECTION 23 8239.19  
WALL AND CEILING UNIT 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 wall and ceiling heaters with propeller fans and electric-resistance heating coils.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and 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 details of anchorages and attachments to structure and to supported equipment.
  - 4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
  - 5. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wall and ceiling unit heaters to include in emergency, operation, and maintenance manuals.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berko; Marley Engineered Products.
  - 2. Chromalox, Inc.
  - 3. INDEECO.
  - 4. Markel Products; TPI Corporation.
  - 5. Marley Engineered Products.
  - 6. QMark; Marley Engineered Products.

**2.2 DESCRIPTION**

- A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

- 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 CABINET**

- A. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.
- B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

### **2.4 COIL**

- A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

### **2.5 FAN AND MOTOR**

- A. Fan: Aluminum propeller directly connected to motor.
- B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

### **2.6 CONTROLS**

- A. Controls: Unit-mounted thermostat with tamper resistant cover or Remote-mounted thermostat with low-voltage relay with transformer kit.
- B. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

### **2.7 CAPACITIES AND CHARACTERISTICS**

- A. See schedules on drawings.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas to receive wall and ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install wall and ceiling unit heaters to comply with NFPA 90A.
- B. Install wall and ceiling unit heaters level and plumb.
- C. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

**END OF SECTION 23 8239.19**

**SECTION 260500  
COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL REFERENCE AND 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. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.
- C. Refer to Division 01 section "Alternates" for possible alternates affecting the extent of this section of work.
- D. This Contractor is also referred to the Architectural, Structural, Mechanical and all other drawings and specification pertinent to this project. All of the above-mentioned drawings and specifications are considered a part of the Contract Documents.
- E. This section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

**1.2 SUMMARY**

- A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
  - 1. Shop Drawings
  - 2. Definitions
  - 3. Discrepancies
  - 4. Record drawings
  - 5. Equipment
  - 6. Substitutions
  - 7. Codes and permits
  - 8. Coordination
  - 9. Interferences
  - 10. Delivery, storage and handling
  - 11. Punchlists
  - 12. Operating and maintenance
  - 13. Warranties
- B. Related Sections: The following sections contain requirements that relate to this Sections:
  - 1. Division 23 Section "ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT", for factory-installed motors, controllers, accessories, and connections.
  - 2. Division 26 Section "COMMON ELECTRICAL MATERIALS AND METHODS", for materials and methods common to the remainder of Division 26.

**1.3 SHOP DRAWINGS**

- A. Product Data: Submit manufacturer's technical product data, including the recommended installation method, all in accordance with Division 01 and Section 26 requirements.

**1.4 DEFINITIONS**

- A. To achieve brevity in Specification and on Drawings, certain words and phrases not contributing to clarity have been omitted. Unless mentioned specifically as work to be done by Other Trades, all requirements contained in the Specifications and shown on the Drawings shall be performed by the Principal Contractor for this Division of the Contract. The following definitions shall apply:
  - 1. Where the work "provide" is used in connection with a system, equipment, or time, it shall be construed to mean the furnishing and installing of the system, equipment or item.

2. Where the phrases “as directed” is used it shall be construed to mean as directed by the Architect or their authorized representative.
- B. The term “Contractor” as applied to work specified, shown or reasonably implied in the contract documents for Division 26 shall be defined as the subcontractor who is responsible for the work specified or indicated. All subcontracted work must be incorporated by and coordinated by the Prime Contractor.
- C. The term “Contractor” as applied to work specified, shown or reasonable implied in the contract documents for Division 26 shall be defined as the prime contractor who is responsible for the work specified, or indicated. All work subcontracted to each prime contractor must be incorporated by the coordinated by each prime contractor.

## 1.5 DISCREPANCIES

- A. Should it appear that there is a discrepancy between or within the drawings and/or specifications concerning the nature, quality or extent of materials or work to be furnished and/or installed, and such discrepancy is not clarified by Addendum during the bidding period, this Contractor shall base his bid on performing the work in the manner having the higher cost. The Architect shall have the option of selecting either of the manners shown and/or specified. In the event the lower cost manner is selected, a credit shall be due the Owner in the amount of the difference between the lower cost and higher cost manner. All discrepancies shall be called to the attention of the Architect before proceeding with work affected thereby.
- B. Should it appear that there is a duplication on the Drawings or in the Specifications, wherein the same work or items are shown or specified as being provided under different contracts, subcontracts or supply orders, and such duplication is not clarified by Addendum during the bidding period, it shall be assumed that the prime contractors have included duplicate quotations in their proposal to the Owner. The Architect shall have the option of selecting the contract, subcontract or supply order under which the work or items are to be provided and a credit shall be due the Owner for the duplicate work or items.
- C. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, electrical devices, etc. unless dimensions are given. Drawings are not to be scaled.
  1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer’s instructions.
    - a. Provide at least the minimum manufacturer’s recommended and code required clearance around the equipment for normal maintenance.
    - b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.
  2. Raceways are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional bends, pull and splice boxes shall be provided as necessary to meet space constraints and to facilitate the work of other trades.
- D. Electrical equipment, specified hereinafter or as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.
- E. Occasionally, certain references may be indicated on the drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor’s bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor’s responsibility that all items covered on electrical plans and Division 26 specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor’s failure to include all applicable electrical work in his bid.
- F. Where more than one manufacturer is named for major items of equipment, the manufacturer noted on the Drawings has been used as a basis for design. If another manufacturer is used, other than the one named on the Drawings, it shall be the responsibility of this contractor to



ensure that the equipment will fit the space with all legal clearances, or bear the expense to change the space and structure to accommodate equipment used.

#### **1.6 RECORD DRAWINGS**

- A. Prepare record documents in accordance with the requirements of this division, and in Division 01.
- B. This Contractor shall record all changes from original design drawings which were made during the installation of the work. These changes shall be recorded in red ink on a designated set of drawings. Changes shall be accurately dimensioned and/or drawn to scale.
- C. This Contractor shall keep an updated set of specifications and drawings, including changes on the job site, at all times and shall submit one (1) set of updated and legible drawings to the Architect when the work is complete.

#### **1.7 EQUIPMENT**

- A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that an equipment manufacturer has been regularly engaged in the manufacturing of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.
- B. When two or more items of same equipment are required (panelboards, switchboards, transformers, etc.) they shall be of the same manufacturer.

#### **1.8 SUBSTITUTIONS**

- A. Refer to the Instructions to Bidders and the related Division 01 sections for requirements in selecting products and requesting substitutions.
- B. Bids concerning the use of substitute products must be accompanied by complete specifications and performance characteristics covering these products, together with such available test data and experience records as may be helpful to the Engineer in evaluating the quality and/or suitability of the proposed products.
- C. When more than one make or name is mentioned as being acceptable, it shall be understood that only the name or make referring to the manufacturer's model numbers or sizes shall be considered the "Specified Standard". It shall be further understood that other makes and names, even though mentioned, have not been checked for detail and that their size and arrangement are the Contractor's responsibility the same as a proposed substitute item.
- D. The intent of this paragraph is to make the specifications open to all available makes of material and apparatus during the bidding period. Certain definite makes or kinds of items are specified as "standards of quality" and character required. This Contractor is required to bid upon the basis of furnishing the makes specified. He is also invited to bid on any other similar makes he (the Contractor) may desire to propose as substitutions, stating any difference in cost (if any) for each proposed substitution on either the Proposal or the Voluntary Substitution Sheets. If Engineer decides to accept proposed substitutions, proper notations shall be made in the written contract. Where several makes are mentioned in the specifications and the Contractor fails to state that he prefers a particular make in his bid, the Owner shall have the right to choose any of the makes mentioned without change in price. No consideration will be given to proposals for alternative products unless submitted with the original bids.

#### **1.9 CODE AND PERMITS**

- A. All equipment, materials and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.
- B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any requirements of specification which are in excess of Code requirements and not in conflict therewith.

- C. Unless otherwise indicated, secure and pay for all permits and certificates of inspection incidental to this work required by foregoing authorities. Be responsible for payments to all public utilities for temporary service work performed by them in connection with provision of temporary service required under this Division of specifications. Deliver all certificated to Architect in duplicate.

#### **1.10 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- E. Unless otherwise additionally required in "Project Coordination" sections, prepare and submit for approval coordination drawings drawn to readable scale of all areas where equipment or materials are being used which are not basis of specification and result in a change in the accessibility, performance, or serviceability of such equipment, or a conflict with other trades. Such equipment or materials shall not be installed until it receives approval from the Engineer.

#### **1.11 INTERFERENCES**

- A. Before installing any work, this Contractor shall see that it does not interfere with clearance required for finish on beams, columns, pilasters, walls or other structural or architectural members, as shown on Architectural Drawings. If any work is so installed and it later develops that Architectural design cannot be followed, Contractor shall, at his own expense, make such changes in his work as the Architect may direct to permit completion of Architectural work in accordance with plans and specifications.
- B. Install additional conduit, pullboxes, spliceboxes, etc. where required to obtain maximum headroom or to avoid conflict with other work without additional cost to the Owner. Where mounting heights are not detailed or dimensioned, install electrical conduit and overhead equipment to provide the maximum headroom possible.
- C. Report any interferences between work under this division and that of any other Contractors to the Architect as soon as they are discovered. The Architect will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

#### **1.12 DELIVERY, STORAGE, AND HANDLING**

- A. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

#### **1.13 PUNCHLISTS**

- A. From time to time throughout the course of the work, or upon completion of the work the Engineer may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to

each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Engineer. Contractor shall submit the responses to these items as part of the closeout documentation.

**1.14 OPERATING AND MAINTENANCE**

- A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 26 specification sections in the proper operation of the electrical equipment. He shall also supply the Owner with one (1) hardbound copy and (1) electronic copy of an operation manual containing the following:
  - 1. Step-by-step procedures for start-up and operation for each system and piece of equipment.
  - 2. Performance data, curves, ratings.
  - 3. Wiring diagrams.
  - 4. Manufacturer's descriptive literature.
  - 5. Manufacturer's maintenance and service manuals.
  - 6. Spare parts and replacement parts list for each piece of equipment.
  - 7. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
  - 8. Final approved shop drawings.

**1.15 WARRANTIES**

- A. Refer to Division 01 Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.
- B. This Contractor shall warranty all materials, workmanship and the successful operation of all equipment and apparatus installed by him for a period of one year from the date of the final acceptance of the entire work and shall guarantee to repair to replace at his own expense any part of the apparatus which may show defect during that time provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not to carelessness or improper use. Compile and assemble the warranties specified in Division 26 into a separated set of vinyl covered three-ring binders, tabulated and indexed for easy reference.

**PART 2 - PRODUCTS (NOT APPLICABLE)**

**PART 3 - EXECUTION (NOT APPLICABLE)**

**END OF SECTION 260500**

**SECTION 260501  
COMMON ELECTRICAL MATERIALS AND METHODS**

**PART 1 GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 DESCRIPTION OF WORK**

- A. Extent of electrical related work required by this section is indicated on drawings and/or specified in other Division 26 sections.
- B. Except as noted in this specification, this Contractor shall be responsible for all excavating and backfilling necessary to the work of this Division.
- C. See specification Division 09 for painting requirements. Coordinate all electrical painting work required. Coordinate protection requirements for electrical equipment which could be damaged by painting.
- D. Furnish and install all miscellaneous steel required for supports, hangers, anchors, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a damp or wet environment shall be hot dipped galvanized unless otherwise noted.
- E. Furnish and install all miscellaneous lumber required for support of electrical equipment, telephone backboards, etc.
- F. This Contractor shall furnish and install concrete foundations or bases under all electrical equipment that rests on floors, concrete encased ductbanks and exterior lighting fixture pole bases. The Contractor shall follow drawings and/or manufacturer's literature with regard to design and construction of same.
- G. Furnish and install fire stopping for sealing around electrical penetrations through fire or smoke barriers, and floors.
- H. This Contractor shall perform all Division 26 related and indicated demolition including: Nondestructive removal of materials and equipment for re-use or salvage as indicated. All equipment removed shall be offered to the Owner for his retention. If the Owner elects to retain equipment, it shall be turned over to the Owner at the site. If not, the equipment shall be removed from the premises by this Contractor. Refer to Division 02 Section "Selective Demolition" for additional requirements.

**1.3 SUMMARY**

- A. This section includes a limited scope of general construction materials and methods pertaining to Division 26 applications of the following items:
  - Excavation and backfilling
  - Miscellaneous Metal
  - Concrete work
  - Rough-ins
  - Miscellaneous Lumber
  - Electrical installations
  - Cutting and patching
  - Fire stopping

**1.4 PROJECT CONDITIONS**

- A. Conditions Affecting Demolition: The following project conditions apply:
  - 1. Protect adjacent materials to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

2. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
    1. Maintain and protect existing building services which transit the area affected by excavation.
    2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
    3. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
  - C. Notify proper authorities prior to commencing excavation. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
  - D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights. Where trenches cross roads, walks, or public thoroughfares, provide suitable barricades and bridges adequately protected by signs or red flags during day and lights at night.
  - E. Operate warning lights as recommended by authorities having jurisdiction.
  - F. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

## 1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including the recommended installation method, all in accordance with Division 01 and Section 260500 requirements.
- B. Electrical Penetration Seals: Submit the following:
  1. Shop drawings showing each condition requiring penetration seals. Indicate proposed UL systems materials, anchorage, methods of installation, and actual adjacent construction.
  2. A copy of UL illustration of each proposed system indicating manufacturer approved modifications.
  3. Manufacturer's specifications, recommendations, installation instructions and maintenance instructions.

## 1.6 SEQUENCE AND SCHEDULING

- A. Coordinate the shut-off and disconnection of electrical service and/or power with the Owner. All associated work to be done at Owner's convenience.
- B. Notify the Architect at least 5 working days prior to commencing demolition operations.
- C. Perform demolition in phases as required by Architect.

## PART 2 PRODUCTS

### 2.1 EXCAVATING FOR ELECTRICAL WORK:

- A. Backfill Materials:
  1. All backfilling within the building shall consist of a 6" layer of sand under the conduit and a 12" layer of sand over the conduit. The remainder of the backfill shall be course interlocking aggregate.
  2. All backfilling outside the building shall be selected dirt, free of large stones.

### 2.2 MISCELLANEOUS METALS

- A. Fasteners: Zinc-coated, type, grade, and class as required.
- B. Metal Framing: As manufactured by Unistrut or Kindorf unless noted otherwise. Provide framing of sizes required by specific application.

### **2.3 MISCELLANEOUS LUMBER**

- A. Electrical backboards to be 5/8" thick ACX-EXT, Non-Com plywood. Paint both sides and all edges with grey fire-retardant paint.

### **2.4 MATERIALS OF CONCRETE WORK**

- A. Reinforcing Materials:
  - 1. Reinforcing Bars: Except as otherwise indicated, provide ASTM A 615, deformed, Grade 40 for size numbers 3 through 18; ASTM A 675, plain, Grade 60, for size number 2; sizes as indicated or required.
- B. Reinforcement Supports: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Provide wire bar type supports complying with CRSI recommendations, unless otherwise indicated.
- C. Concrete Materials:
  - 1. Portland Cement: ASTM C 150, Type I, except as otherwise indicated.
  - 2. Aggregates: ASTM C 33, except as otherwise indicated.
    - a. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used.
    - b. For rough grouting, provide aggregate which is well graded and 100 percent passing through 3/8" sieve.
  - 3. Water: Clean and free of substances harmful to concrete.

### **2.5 DESIGN AND PROPORTIONING OF CONCRETE MIXES**

- A. General: Design electrical work concrete as follows, for each 28-day compressive strength class:
  - 1. 4000 psi Class: 565 lbs. of cement per cu. yd. (6.0 sacks), and 0.35 water/cement ratio.
  - 2. 3000 psi Class: 500 lbs of cement per cu. yd. (5.25 sacks), and 0.46 water/cement ratio.
  - 3. 2500 psi Class: 450 lbs. of cement per cu. yd. (4.75 sacks), and 0.54 water/cement ratio.
  - 4. Rough Grouting Class: 565 lbs. of cement per cu. yd. (6.0 sacks), and 0.60 water/cement ratio.
- B. Mix for Patching: Where electrical work requires patching of exposed concrete work which has been cut to accommodate electrical work, provide concrete patching mix which is identical with mix of work being patched (same cement, aggregates, ad-mixtures and proportioning).

### **2.6 FIRE STOPPING MATERIALS**

- A. Fire stopping materials shall be intumescent safety barriers designed to block the spread of fire and smoke through penetrations created by electrical installations in fire rated walls and floors. Materials shall be flame, toxic fume and water resistant and shall have a minimum 3-hour fire rating. Fire rating shall be defined by tests conducted by ASTM, UL or other testing and inspection agencies acceptable to authorities having jurisdiction.
- B. The fire stopping materials used on the entire project shall be selected and submitted by the general contractor. The electrical contractor and all other trades are to coordinate with the general contractor and provide the same manufacturer and type of materials. The following manufacturers and materials listed below are for reference only.
  - 1. Acceptable Manufacturers:
    - Specified Technologies, Inc. (STI) Somerville, NJ
    - Tremco, Inc. Beachwood, OH
    - 3M Inc., Minneapolis, MN
  - 2. Materials:
    - a. Firestop Mortar:
      - STI SpecSeal Mortar
      - Tremco TREMstop-M
      - 3M Fire Barrier Mortar
    - b. Intumescent Firestop Sealants and Caulks
      - SpecSeal SSP Putty
      - Tremco TREMstop-WBM

- c. 3M Fire Barrier CP-25 WB  
Silicone Firestop Sealants Caulks  
STI SpecSeal Pensil 100 & 300  
Tremco Fyre Sil Sealant  
3M Fire Barrier 2000 & 2003
  - d. Firestop Putty:  
STI SpecSeal Firestop Putty Bars & Pads  
Tremco TREMstop FP Flowable Putty  
3M Fire Barrier Firestop Putty
  - e. Firestop Collars:  
STI SpecSeal Firestop Collars  
Tremco TREMstop D Combustible Pipe Device  
3M Fire Barrier Pipe Device
  - f. Wrap Strip:  
STI Spec Seal Wrap Strip  
Tremco TREMstop-WS  
3M Fire Barrier WS-195 Wrap Strip
- C. Sleeves shall be Schedule 40, galvanized steel with plain end. Sleeves shall be no more than two sizes larger than single penetrating conduit. For multiple cable or conduit penetrations, make sleeve as small as possible to allow for penetrating items and firestopping material.

## 2.7 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 EXECUTION

### 3.1 EXAMINATION AND PROJECT CONDITIONS

- A. Examine area and conditions under which basic electric materials are to be installed or methods are to be performed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

### 3.2 EXCAVATION AND BACKFILLING

- A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.
- B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
  - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- C. Install sediment and erosion control measures in accordance with local codes and ordinances.
- D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
- E. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
  2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- F. Excavation for Underground Vaults and Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
1. Excavate, by hand, areas within dip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
  2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is place.
- G. Trenching: Excavate trenches for electrical installations as follows:
1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of raceways and equipment.
  2. Excavate trenches to depth as required.
  3. Limit the length of open trench to that in which installations can be made and the trench backfilled within the same day.
  4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel to 6" below conduit.
- H. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F (1 deg C).
- I. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a course interlocking aggregate ODOT #6, 67, 68, 7, 78 or 8 equivalent.
  2. Under building slabs, use a course interlocking aggregate ODOT #6, 67, 68, 7, 78 or 8 or equivalent.
  3. Under conduit and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
  4. For raceways less than 30 inches below surface of roadways, provide 4-inch thick concrete base slab support. After installation of raceways, provide a 4-inch thick concrete encasement (side and top) prior to backfilling and placement of roadway subbase.
  5. Other areas, use excavated or borrowed materials, free of large stones.
- J. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
  2. Removal of concrete formwork.
  3. Removal of shoring and bracing, and backfilling of voids.
  4. Removal of trash and debris.
- K. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches of loose depth for material compacted by hand operated tampers.
- L. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
- M. Place backfill and fill materials evenly adjacent to structures, conduit and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- N. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than



the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

- a. Areas Other Than Under Building or Pavement: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- O. Subsidence: Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality and condition of surface or finish to match adjacent areas.

### **3.3 DISPOSAL OF EXCESS AND WASTE EXCAVATION MATERIALS**

- A. Removal from Owner's Property: Remove excess excavated material, trash, debris and waste materials and dispose of it off Owner's property.

### **3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

### **3.5 INSTALLATION OF CONCRETE WORK**

- A. Formwork:
  1. General: Design, construct and maintain formwork to support vertical and lateral loads including pressure of cast-in-place concrete. Construct formwork so that formed concrete will be of required size and shape and in required location. Construct with joints which will not leak cement paste. Form sides and bottoms of concrete work, except where clearly indicated to be cast directly in excavation or against other construction, or on grade or prepared subgrade. Design and construct forms for easy removal without damage to concrete and other work.
    - a. Install chamfer strips at external corners of exposed concrete work.
    - b. Construct forms to retain equipment anchor bolts in accurate locations during placement of reinforcing steel and concrete. Use templates furnished by equipment manufacturers to locate anchor bolts or, where not furnished, locate by accurate measure from certified setting diagrams.
- B. Placing Reinforcement:
  1. General: Comply with requirements and recommendations of specified standards, including "Placing Reinforcing Bars" by CRSI. Place bars where indicated and support to prevent displacement during concrete placement, using appropriate reinforcement supports, properly spaced and wire tied to reinforcing bars.
    - a. Place reinforcement to obtain at least minimum recommended coverages for concrete protection. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
  2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which would reduce bond with concrete.
- C. Placing Concrete:
  1. Wet wooden forms which have been coated with compound, immediately before concrete, and remove excess water from forms.
  2. Strength-Class Application: Comply with the following general application requirements.
    - a. Plain Concrete Encased Ductbanks: Provide 2500 PSI class.
    - b. Reinforced Concrete Encased Ductbanks: Provide 3000 PSI class.
    - c. Underground Structural Concrete: Provide 3000 PSI class.

- d. Concrete Pole Bases: Provide 4000 PSI class.
  - e. Miscellaneous Supported Work: Provide 3000 PSI class for electrical equipment pads and similar supported work.
  - f. Concrete Fill: Provide 2500 PSI class for filling structural steel foundation frames and for filling similar large-volume units.
  - g. Concrete Grout: Provide rough grouting class for filling voids to be grouted which are too small to be filled effectively with 2500 PSI class concrete.
  - h. Patching General Concrete Work: Match concrete being patched.
3. Deposit concrete continuously or in layers of thickness which will result in no concrete being placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within section. If section cannot be placed continuously, provide construction joints. Deposit concrete as nearly as practicable in its final location, so as to avoid segregation due to rehandling or flowing.
  4. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures complying with recommended practices of ACI 309; eliminate voids in work.
  5. Bring horizontal surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps and hollows.
  6. Cold Weather Placement: Comply with ACI 306. Do not use frozen materials or materials containing ice and snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. When air temperature has fallen or is expected to fall below 40 deg F (4.4 deg C), heat water and aggregates uniformly before mixing, as required to obtain concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (26.7 deg C), at time of placement. Protect concrete work from physical damage and reduced strength resulting from frost, freezing actions, or low temperatures.
  7. Finishing Horizontal Surfaces: Float and trowel horizontal (top) surfaces to level, smooth, uniform textured, dense finish, where surface is to remain exposed or receive coating, membrane or other thin-set finish. Otherwise, leave struck-off surface undisturbed; except scratch surfaces which are to receive concrete or mortar topping.
  8. Surface Repairs:
    - a. Unexposed Surfaces: Repair significantly damaged and honeycombed areas, and remove major projections and fins where forms have been removed.
    - b. Exposed Surfaces: On formed surfaces which are to be exposed, including those to be coated or covered with membrane or other thin-set applied finish, repair and patch form-tie holes and damaged and honeycombed areas, filling voids with grout and completely removing fins and other projections.

### **3.6 CONCRETE CURING AND PROTECTION**

- A. General: Protect freshly placed concrete from drying and excessively cold and hot temperatures, and maintain in moist condition at relatively constant temperature for period of time necessary for hydration of cement, proper hardening, and achievement of strength requirements as specified.

### **3.7 MISCELLANEOUS CONCRETE WORK**

- A. Concrete Grouting: Space approximately 1" thick between bottom of equipment and top of concrete foundation or base which remains after shimming, shall be filled completely with grouting. Grout shall be made up with sand and cement designed for the purpose which does not shrink on setting up. Exposed surface of grouting shall be finished to make a neat appearance. Grout openings and recesses as indicated, in and around mechanical work and other work which penetrates or adjoins mechanical concrete work, using rough grouting class of concrete mix. Provide formwork where required, and tamp, screed and trowel surfaces. Cure grout as specified for concrete work.
- B. Concrete Bases: In the absence of more specific information, either on drawings, or manufacturer's literature, the bases shall be level, shall have a minimum height above finished floor of 4" and extend 3" beyond the base dimensions of the item of equipment.

- C. Concrete pads placed in existing structures shall be mounted securely to the original substrate with anchor bolts.

### **3.8 MISCELLANEOUS LUMBER**

- A. Cut, fit and place miscellaneous lumber fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Both sides and all edges of all lumber fabrications shall be painted with two (2) coats of grey fire-retardant paint unless noted otherwise.

### **3.9 ROUGH-IN**

- A. Verify with Architect prior to rough-in, exact location of items such as switches, receptacles, clocks, speakers, fire alarm devices, floor boxes, surface-mounted raceways, etc., in finished areas.
- B. Verify with respective equipment supplier prior to rough-in, exact location and method of connection to respective equipment for such items as mechanical equipment, etc.

### **3.10 ELECTRICAL INSTALLATIONS**

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
  1. Coordinate electrical systems, equipment, and materials installation with other building components.
  2. Verify all dimensions by field measurements.
  3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  4. 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.
  5. 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.
  6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  7. Coordinate connection of electrical systems with exterior underground and/or overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
  8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
  9. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other building systems and components.
  10. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instruction.
    - a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.
    - b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.
  11. Install electrical equipment to facilitate servicing, 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.
  12. Provide access panel or doors where units are concealed behind finished surfaces such as drywall and/or plaster construction, etc. Coordinate the access panel type with the Architect.
  13. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope (such as for underground services, etc.).

14. All wiring other than within an item of equipment, to be in raceways unless shown otherwise on Drawings or covered otherwise in these Specifications.
15. Raceways are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional bends, pull and splice boxes shall be provided as necessary to meet space constraints and to facilitate the work of other trades.
16. Raceways, boxes, cables, conductors, etc., installed in plenum spaces and similar areas shall be supported from the building structure and shall be installed symmetrical with the axis of the space (do not cross room at an angle). Support wires for lay-in type grid ceilings shall not be used to support electrical equipment, raceways, cables, etc.
17. Wiring of Motors and/or Equipment:
  - a. Provide necessary power wiring to motors and/or equipment where shown on Drawings.
    - 1.) Make final "line" connections to respective items of equipment as shown on Drawings.
    - 2.) Provide "Control" wiring, regardless of voltage, only when shown on Electrical Drawings.
    - 3.) In general, all 120, 208, 240, 277, or 480 volt wiring to be construed as power wiring; however, line voltage control wiring shall not be construed as power wiring unless shown on Electrical Drawings.
18. Wiring of Heating, Ventilating, and Air Conditioning Equipment:
  - a. Provide power wiring as shown on Electrical Drawings. In general, this shall consist of power conductors and raceway up to and including connections to line terminals of respective items of equipment.
    - 1.) Where this Contractor furnishes motor starter and/or disconnect switch, this also shall include the power wiring between the load side of starter and/or disconnect switch and line terminals of respective item of equipment.
    - 2.) Where other Divisions furnish motor starter and/or disconnect switch (other than factory-mounted, prewired items), this Contractor shall provide power wiring as described in previous paragraph and shall mount respective starter and/or disconnect switch.
    - 3.) Where electric heating equipment is involved, wiring responsibilities to be as shown on Electrical Drawings.
    - 4.) Control wiring, regardless of voltage characteristics, is not to be construed as power wiring and is not the responsibility of this Contractor unless indicated as such on Electrical Drawings.  
 In certain cases, such as between a thermostat and a cabinet heater or a unit heater, or between a switch and a small exhaust fan, wiring may be required by this Contractor only if shown on Electrical Drawings.
    - 5.) It shall be the responsibility of this Contractor, prior to rough-in of conduits serving mechanical equipment, to verify with respective equipment supplier the required ampacity and quantity of conductors serving the equipment. In the event changes are required from those shown on the Drawings, this information shall be brought to the attention of the Engineer and authorization obtained from the Engineer in writing prior to proceeding with the necessary changes. Changes required shall be performed at the expense of the mechanical (HVAC or plumbing) contractor.
19. Wiring of Plumbing Equipment:
  - a. Provide necessary power wiring to plumbing equipment requiring same, where shown on Electrical Drawings.

- b. Control equipment such as thermostats, pressure switches, etc., to be furnished, set in place, and wired by other Divisions, unless shown otherwise on Electrical Drawings.
  - c. Provide necessary disconnect switches, starters, or contactors where shown on Electrical Drawings. See "MOTOR CONTROL" section of these Specifications.
20. Temperature Control Wiring:
- a. Temperature control wiring, regardless of voltage characteristics, is not the responsibility of this Contractor unless indicated as such on Electrical Drawings or herein described.
    - 1.) In general, the furnishing and installing of all temperature control devices and respective wiring shall be the responsibility of other Divisions.
21. Wiring of Motor Operated or Automatic Doors:
- a. All control devices, such as pushbuttons, limit switches, etc., shall be furnished by other Divisions, and installed and wired by this contractor, unless shown otherwise on the Electrical Drawings.
  - b. Power wiring up to and including connection to the overhead door motor system main control panel or junction box, and to the motor from same, if not factory prewired shall be the responsibility of this Contractor.

### 3.11 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 01 Section "CUTTING AND PATCHING". In addition to the requirements specified in Division 01, the following requirements apply:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover work to provide for installation of ill-timed work.
    - b. Remove and replace defective work.
    - c. Remove and replace work not conforming to requirements of the Contract Documents.
    - d. Upon written instructions from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.
  2. Cut, remove, and legally dispose of electrical equipment, components, and materials, including but not limited to electrical items to be removed and items made obsolete by the new work.
  3. Protect the structure, furnishings, finishes, and adjacent materials not to be removed.
  4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
  5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
  6. General penetrations through walls, floors, slab, etc. will be patched with materials to match the surrounding surface (i.e. vinyl concrete patch for concrete surfaces, joint and patching compound for dry wall surfaces, etc.). If the penetrated surface is a fire or smoke barrier, refer to "Installation of Fire Stopping Materials" in this section.

### 3.12 INSTALLATION OF FIRE-STOPPING MATERIAL

- A. General:
1. All fire and smoke rated walls and floors penetrated by electrical raceways, exposed conductors, etc. shall be properly sleeved and fire sealed. See Division 7 "Firestopping". All firestop system types shall be by same manufacturer to fullest extent possible.
  2. All fire stopping will be installed in accordance to the U.L. rated system designed for the application.
  3. Insulation types specified in other sections shall not be installed in lieu of firestopping material specified herein.
  4. Grout, Mortar, or Gypsum products shall not be installed in lieu of firestopping material specified here.
- B. Sleeves:

1. Wall and floor opening shall be made as small as possible. Install sleeves during the erection of concrete or masonry walls. Sleeve shall be grouted in using material to match surrounding surface. Install electrical raceway, exposed conductors, etc. through sleeve and install fire stopping, intumescent material.
- C. Penetrations - Provide Firestopping:
1. Where penetrations including conduit, cable, wire, or other elements which pass through one or both outer surfaces of a fire rated floor or wall.
  2. Except for floor on grade, where a penetration occurs through a structural floor or roof and a space would otherwise remain open between the surfaces of the penetration and the edge of the adjoining structural floor or roof.
  3. Where a penetration occurs through fire-rated walls, or partitions of hollow-type construction, provide fire stopping to completely fill spaces around the penetration, on each side of the wall or partition.
  4. These requirements for penetrations shall apply whether or not sleeves have been provided, and whether or not penetrations are to be equipped with escutcheons or other trim. If penetrations are sleeved, fire stop annular space, if any, between sleeve and wall opening.
- D. Provide fire stopping to fill miscellaneous voids and blank openings in fire-rated construction where conduit, cable, wire or equipment has been removed.

**END OF SECTION 260501**

**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Aluminum building wire rated 600V or less.
  - 3. Metal-clad cable, Type MC, rated 600 V or less.
  - 4. Connectors, splices, and terminations rated 600 V or less.

**1.3 DEFINITIONS**

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

**1.4 SUBMITTALS**

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

**1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

**PART 2 - PRODUCTS**

**2.1 COPPER BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Okonite Company (The).
  - 8. Service Wire Co.
  - 9. Southwire Company.
  - 10. WESCO.
  - 11. West Penn.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. RoHS compliant.
  - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.

## **2.2 ALUMINUM BUILDING WIRE**

- A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Okonite Company (The).
  - 8. Service Wire Co.
  - 9. Southwire Company.
  - 10. WESCO.
  - 11. West Penn.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.
- E. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.

## **2.3 METAL-CLAD CABLE, TYPE MC**

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath in 6' length or less from J-box to lighting fixture or as approved by the Project Manager.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems; a part of Atkore International.
  - 2. Alpha Wire Company.
  - 3. American Bare Conductor.
  - 4. Belden Inc.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Okonite Company (The).
  - 8. Service Wire Co.
  - 9. Southwire Company.
  - 10. WESCO.
- C. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Comply with UL 1569.
  - 3. RoHS compliant.
  - 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  - 1. Single circuit and multicircuit with color-coded conductors.



- E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated.
- G. Conductor Insulation:
  1. Type THHN/THWN-2: Comply with UL 83.
- H. Armor: Steel, interlocked.

## **2.4 CONNECTORS AND SPLICES**

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. 3M Electrical Products.
  2. AFC Cable Systems; a part of Atkore International.
  3. Gardner Bender.
  4. Hubbell Power Systems, Inc.
  5. Ideal Industries, Inc.
  6. ILSCO.
  7. NSi Industries LLC.
  8. O-Z/Gedney; a brand of Emerson Industrial Automation.
  9. Service Wire Co.
  10. TE Connectivity Ltd.
  11. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
  1. Material: Copper or aluminum as suited to application.
  2. Type: One hole with standard barrels.
  3. Termination: Crimp.

## **PART 3 - EXECUTION**

### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Feeders: Aluminum, stranded
- B. Branch Circuits: Copper; stranded for No. 12 AWG and larger.

### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuit Home Runs Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### **3.5 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.7 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### **3.8 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Inspect compression-applied connectors for correct cable match and indentation.
    - c. Inspect for correct identification.
    - d. Inspect cable jacket and condition.
- B. Cables will be considered defective if they do not pass tests and inspections.

**END OF SECTION 260519**

**SECTION 260526  
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section includes grounding and bonding systems and equipment.

**1.3 SUBMITTALS**

- A. Qualification Data: For testing agency and testing agency's field supervisor.
- B. Field quality-control reports.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. include the following:
    - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
      - 1) Ground rods.

**1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Certified by NETA.

**PART 2 - PRODUCTS**

**2.1 SYSTEM DESCRIPTION**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

**2.2 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advanced Lightning Technology, Ltd.
  - 2. Burndy; Part of Hubbell Electrical Systems.
  - 3. Dossert; AFL Telecommunications LLC.
  - 4. ERICO; a brand of nVent.
  - 5. Fushi Copperweld Inc.
  - 6. Galvan Industries, Inc.; Electrical Products Division, LLC.
  - 7. Harger Lightning & Grounding.
  - 8. ILSCO.
  - 9. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 10. Robbins Lightning, Inc.

11. Siemens Industry, Inc., Energy Management Division.
12. Thomas & Betts Corporation; A Member of the ABB Group.

## **2.3 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  6. 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- K. Straps: Solid copper, copper lugs. Rated for 600 A.
- L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- M. Water Pipe Clamps:
  1. Mechanical type, two pieces with zinc-plated bolts.
    - a. Material: Tin-plated aluminum.
    - b. Listed for direct burial.
  2. U-bolt type with malleable-iron clamp and copper ground connector.

## **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. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install barecopper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
  2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
1. Install bus horizontally, on insulated spacers.
- D. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Exothermic welded connectors as indicated.
  3. Connections to Structural Steel: Exothermic 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 UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install four ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### **3.4 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.

### **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 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. Use exothermic welds for all below-grade connections.
  3. 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.
- C. 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.
- D. 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.
- E. 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.
- F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  2. Make connections with clean, bare metal at points of contact.
  3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 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, at ground test wells. 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 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: 1 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 260526**

**SECTION 260529  
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Steel slotted support systems.
  - 2. Conduit and cable support devices.
  - 3. Support for conductors in vertical conduit.
  - 4. Structural steel for fabricated supports and restraints.
  - 5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
  - 6. Fabricated metal equipment support assemblies.
- B. Related Requirements:
  - 1. Conduit supports on roof non-penetration product specifically designed for conduit support.
  - 2. Product shall be approved by roofing manufacturer to retain roofing warranty.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
    - d. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
  - 1. Hangers. Include product data for components.
  - 2. Slotted support systems.
  - 3. Equipment supports.
- C. Welding certificates.

**1.4 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.



## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D 635.

### **2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. B-line, an Eaton business.
    - c. CADDY; a brand of nVent.
    - d. Flex-Strut Inc.
    - e. Gripple Inc.
    - f. GS Metals Corp.
    - g. G-Strut.
    - h. Haydon Corporation.
    - i. Metal Ties Innovation.
    - j. MIRO Industries.
    - k. Thomas & Betts Corporation; A Member of the ABB Group.
    - l. Unistrut; Part of Atkore International.
    - m. Wesanco, Inc.
  - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
  - 4. Channel Width: 1-1/4 inches.
  - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti, Inc.

- 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
  - 3) MKT Fastening, LLC.
  - 4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) B-line, an Eaton business.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti, Inc.
      - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All Stainless-steel springhead type.
  7. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA 101
  3. NECA 102.
  4. NECA 105.
  5. NECA 111.
- B. Provide firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.5 PAINTING**

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

**END OF SECTION 260529**

**SECTION 260533  
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Metal wireways and auxiliary gutters.
  - 4. Nonmetal wireways and auxiliary gutters.
  - 5. Boxes, enclosures, and cabinets.
- B. Related Requirements:
  - 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

**1.3 DEFINITIONS**

- A. GRC: Galvanized rigid steel conduit.

**1.4 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

**PART 2 - PRODUCTS**

**2.1 METAL CONDUITS AND FITTINGS**

- A. Metal Conduit:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Adalet, Inc.
    - b. AFC Cable Systems; a part of Atkore International.
    - c. Allied Tube & Conduit; a part of Atkore International.
    - d. Amp.
    - e. Anamet Electrical, Inc.
    - f. Appleton Electric Co.
    - g. Arlington Industries Inc.
    - h. Calconduit.
    - i. Electri-Flex Company.
    - j. FSR Inc.
    - k. Hubbell, Inc.
    - l. Korkap.
    - m. NEC, Inc.

- n. Opti-Com Manufacturing Network, Inc (OMNI).
  - o. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - p. Republic Conduit.
  - q. Southwire Company.
  - r. Thomas & Betts Corporation; A Member of the ABB Group.
  - s. Western Tube and Conduit Corporation.
  - t. Wheatland Tube Company.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. GRC: Comply with ANSI C80.1 and UL 6.
  4. EMT: Comply with ANSI C80.3 and UL 797.
  5. FMC: Comply with UL 1; zinc-coated steel.
  6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFC Cable Systems; a part of Atkore International.
    - b. Allied Tube & Conduit; a part of Atkore International.
    - c. Anamet Electrical, Inc.
    - d. Electri-Flex Company.
    - e. FSR Inc.
    - f. Korkap.
    - g. NEC, Inc.
    - h. NewBasis.
    - i. Opti-Com Manufacturing Network, Inc (OMNI).
    - j. O-Z/Gedney; a brand of Emerson Industrial Automation..
    - k. Perma-Cote.
    - l. Republic Conduit.
    - m. Southwire Company.
    - n. Thomas & Betts Corporation; A Member of the ABB Group.
    - o. Western Tube and Conduit Corporation.
    - p. Wheatland Tube Company.
  2. Comply with NEMA FB 1 and UL 514B.
  3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  4. Fittings, General: Listed and labeled for type of conduit, location, and use.
  5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  6. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew.
  7. 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.
- C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Nonmetallic Conduit:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFC Cable Systems; a part of Atkore International.
    - b. Anamet Electrical, Inc.
    - c. Arnco Corporation.

- d. CANTEX INC.
  - e. CertainTeed Corporation.
  - f. Condux International, Inc.
  - g. Electri-Flex Company.
  - h. FRE Composites.
  - i. Lamson & Sessions.
  - j. Niedax Inc.
  - k. RACO; Hubbell.
  - l. Thomas & Betts Corporation; A Member of the ABB Group.
  - m. Topaz Electric; a division of Topaz Lighting Corp.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. ENT: Comply with NEMA TC 13 and UL 1653.
  4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
  5. LFNC: Comply with UL 1660.
  6. Rigid HDPE: Comply with UL 651A.
  7. Continuous HDPE: Comply with UL 651A.
  8. RTRC: Comply with UL 2515A and NEMA TC 14.
- B. Nonmetallic Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AFC Cable Systems; a part of Atkore International.
    - b. Anamet Electrical, Inc.
    - c. Arnco Corporation.
    - d. CANTEX INC.
    - e. CertainTeed Corporation.
    - f. Condux International, Inc.
    - g. Electri-Flex Company.
    - h. FRE Composites.
    - i. Kraloy.
    - j. Lamson & Sessions.
    - k. Niedax Inc.
    - l. RACO; Hubbell.
    - m. Thomas & Betts Corporation; A Member of the ABB Group.
    - n. Topaz Electric; a division of Topaz Lighting Corp.
  2. Fittings, General: Listed and labeled for type of conduit, location, and use.
  3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
    - a. Fittings for LFNC: Comply with UL 514B.
  4. Solvents and Adhesives: As recommended by conduit manufacturer.

### 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. B-line, an Eaton business.
  2. Hoffman; a brand of nVent.
  3. MonoSystems, Inc.
  4. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 and/or Type 3R unless otherwise indicated, and sized according to NFPA 70.
  1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged for type 3R, screw-cover for type 1 unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Allied Moulded Products, Inc.
  2. Hoffman; a brand of nVent.
  3. Lamson & Sessions.
  4. Niedax Inc.
- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

## 2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Adalet.
  2. Crouse-Hinds, an Eaton business.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. FSR Inc.
  6. Hoffman; a brand of nVent.
  7. Hubbell Incorporated.
  8. Hubbell Incorporated; Wiring Device-Kellems.
  9. Kraloy.
  10. Milbank Manufacturing Co.
  11. MonoSystems, Inc.
  12. Oldcastle Enclosure Solutions.
  13. O-Z/Gedney; a brand of Emerson Industrial Automation.
  14. Plasti-Bond.
  15. RACO; Hubbell.
  16. Spring City Electrical Manufacturing Company.
  17. Stahlin Non-Metallic Enclosures.
  18. Thomas & Betts Corporation; A Member of the ABB Group.
  19. Topaz Electric; a division of Topaz Lighting Corp.
  20. 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. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
  1. Material: Cast metal or sheet metal.



2. Type: Fully adjustable.
  3. Shape: Rectangular.
  4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep for power 5 inches square x 2-1/8 inches deep for telecom.
- L. Gangable boxes are allowed.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 and/or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures: Plastic.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Cabinets:
1. NEMA 250, Type 1 and/or Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.

### **PART 3 - EXECUTION**

#### **3.1 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.
  3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC,.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - b. Mechanical rooms.
    - c. Garages
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: GRC.
  7. 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 trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use setscrew, steel 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. Do not install nonmetallic conduit where ambient temperature exceeds 90 deg F.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. 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.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction. Pull point shall be no more than 200 linear feet.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:
  1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  3. Arrange raceways to keep a minimum of 1 inch 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 PVC coated GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
  1. Use EMT or GRC for raceways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. 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.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

- R. 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.
- S. Cut conduit perpendicular to the length and deburr. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- U. 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.
- V. 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. Conduit extending from interior to exterior of building.
  4. Conduit extending into pressurized duct and equipment.
  5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  6. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- X. Expansion-Joint Fittings:
  1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

- AA. 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.
- BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- CC. Locate boxes so that cover or plate will not span different building finishes.
- DD. 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.
- EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### **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 "Earthwork for Utilities" for pipe less than 6 inches in nominal diameter.
  2. Install backfill as specified in Section 312000 "Earthwork for Utilities."
  3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earthwork for Utilities."
  4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
  6. 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.

### **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 260533**

**SECTION 260543**  
**UNDERGROUND DUCTS AND RACEWAYS 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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Rigid nonmetallic duct.
  - 2. Flexible nonmetallic duct.
  - 3. Duct accessories.

**1.3 DEFINITIONS**

- A. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- B. Duct Bank:
  - 1. Two or more ducts installed in parallel, with or without additional casing materials.
  - 2. Multiple duct banks.
- C. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  - 3. Include underground-line warning tape.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Source quality-control reports.
- B. Field quality-control reports.

**1.6 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

**1.7 FIELD CONDITIONS**

- A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

## **PART 2 - PRODUCTS**

### **2.1 RIGID NONMETALLIC DUCT**

- A. Underground Plastic Utilities Duct: Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. <Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ARNCO Corp.
  - 2. Beck Manufacturing.
  - 3. CANTEX INC.
  - 4. CertainTeed Corporation.
  - 5. Condux International, Inc.
  - 6. Crown Line Plastics.
  - 7. ElecSys, Inc.
  - 8. Electri-Flex Company.
  - 9. Endot Industries Inc.
  - 10. IPEX USA LLC.
  - 11. Lamson & Sessions.
  - 12. Manhattan/CDT.
  - 13. National Pipe & Plastics.
  - 14. Opti-Com Manufacturing Network, Inc (OMNI).
  - 15. Spiraduct/AFC Cable Systems, Inc.
- C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

### **2.2 DUCT ACCESSORIES**

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. CANTEX INC.
    - c. Carlon; a brand of Thomas & Betts Corporation.
    - d. IPEX USA LLC.
    - e. PenCell Plastics.
    - f. Underground Devices, Inc.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Coordinate layout and installation of duct banks with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

### **3.2 UNDERGROUND DUCT APPLICATION**

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-40-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.
- C. Underground Ducts Crossing Paved Paths Walks and Driveways Roadways and Railroads: Type EPC-40 PVC RNC, encased in reinforced concrete.
- D. Stub-ups: Concrete-encased GRC.

### **3.3 EARTHWORK**

- A. Excavation and Backfill: Comply with Section 312000 "Earthwork for Utilities," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Lawns and Grasses".
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures.

### **3.4 DUCT AND DUCT-BANK INSTALLATION**

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
  - 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.
- D. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- E. Building Wall Penetrations: Make a transition from underground duct to suitable raceway with the building wall, without reducing duct line slope away from the building and without forming a trap in the line.
- F. Sealing: Refer to 260544, Sleeves and Sleeve Seals for Electrical Raceways and Cabling
- G. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
- H. Concrete-Encased Ducts and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork for Utilities" for pipes less than 6 inches in nominal diameter.
  - 2. Width: Excavate trench 12 inches wider than duct on each side.
  - 3. Width: Excavate trench 3 inches wider than duct on each side.
  - 4. Depth: Install so top of duct envelope is at least 36 inches below finished grade.
  - 5. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than fivespacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 7. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 12 inches between power and communications ducts.
  - 8. Elbows: Use manufactured schedule 80 PVC duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
  - 9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.



10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
  11. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 12 inches between power and communications ducts.
  12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
    - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
    - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
  13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
- I. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

### **3.5 GROUNDING**

- A. Ground underground ducts according to Section 260526 "Grounding and Bonding for Electrical Systems."

### **3.6 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### **3.7 CLEANING**

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

**END OF SECTION 260543**

**SECTION 260544**  
**SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.

**1.3 SUBMITTALS**

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

**PART 2 - PRODUCTS**

**2.1 SLEEVES**

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

**2.2 SLEEVE-SEAL SYSTEMS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. CALPICO, Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
    - e. Proco Products, Inc.
    - f. GPT, Link-Seal
  - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel.

4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

### **2.3 GROUT**

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## **PART 3 - EXECUTION**

### **3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.2 SLEEVE-SEAL-SYSTEM INSTALLATION**

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

**END OF SECTION 260544**

**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
  - 2. Labels.
  - 3. Bands and tubes.
  - 4. Tapes and stencils.
  - 5. Tags.
  - 6. Signs.
  - 7. Cable ties.
  - 8. Paint for identification.
  - 9. Fasteners for labels and signs.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- C. Dedicated-Design Submittal: For arc-flash hazard study.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Comply with ASME 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. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

**2.2 COLOR AND LEGEND REQUIREMENTS**

- A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on white field.
2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  1. Color shall be factory applied.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
  3. Color for Equipment Grounds: Green.
- C. Warning Label Colors:
  1. Identify system voltage with black letters on an orange background.
- D. Warning labels and signs 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."
- E. Equipment Identification Labels:
  1. Black letters on a white field.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Champion America.
    - c. emedco.
    - d. Grafoplast Wire Markers.
    - e. HellermannTyton.
    - f. LEM Products Inc.
    - g. Marking Services, Inc.
    - h. Panduit Corp.
    - i. Seton Identification Products.
- B. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. Ideal Industries, Inc.
    - g. LEM Products Inc.
    - h. Marking Services, Inc.
    - i. Panduit Corp.
    - j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. A'n D Cable Products.
    - b. Brady Corporation.
    - c. Brother International Corporation.
    - d. emedco.
    - e. Grafoplast Wire Markers.
    - f. HellermannTyton.
    - g. Ideal Industries, Inc.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Panduit Corp.
    - k. Seton Identification Products.
  2. Minimum Nominal Size:
    - a. 1-1/2 by 6 inches for raceway and conductors.
    - b. 3-1/2 by 5 inches for equipment.
    - c. As required by authorities having jurisdiction.

## 2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. HellermannTyton.
    - d. Ideal Industries, Inc.
    - e. Marking Services, Inc.
    - f. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Marking Services, Inc.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. HellermannTyton.
    - b. LEM Products Inc.
    - c. Marking Services, Inc.
    - d. Seton Identification Products.
- D. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Ideal Industries, Inc.
  - c. LEM Products Inc.
  - d. Marking Services, Inc.
  - e. Reef Industries, Inc.
  - f. Seton Identification Products.
2. Tape:
  - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
  - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
  - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
  - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE" .
4. Tag: All maker tape shall be:
  - a. Reinforced, detectable three-layer laminate, consisting of a printed pigmented woven scrim, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - b. Width: 3 inches.
  - c. Overall Thickness: 8 mils.
  - d. Foil Core Thickness: 0.35 mil.
  - e. Weight: 34 lb/1000 sq. ft..
  - f. Tensile according to ASTM D 882: 300 lbf and 12,500 psi.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.5 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. emedco.
    - d. Grafoplast Wire Markers.
    - e. LEM Products Inc.
    - f. Marking Services, Inc.
    - g. Panduit Corp.
    - h. Seton Identification Products.

## 2.6 SIGNS

- A. Baked-Enamel Signs:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Carlton Industries, LP.
    - b. Champion America.
    - c. emedco.
    - d. Marking Services, Inc.
  2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
  3. 1/4-inch grommets in corners for mounting.
  4. Nominal Size: 7 by 10 inches.
- B. Laminated Acrylic or Melamine Plastic Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Carlton Industries, LP.
    - c. Emedco.
    - d. Marking Services, Inc.
- C. Engraved legends:
1. Engraved legend with black letters on white face:
    - a. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
    - b. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
  2. Thickness:
    - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
    - b. For signs larger than 20 sq. in., 1/8 inch thick.

## 2.7 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. HellermannTyton.
  2. Ideal Industries, Inc.
  3. Marking Services, Inc.
  4. Panduit Corp.
- B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and 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.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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 PREPARATION**

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### **3.2 INSTALLATION**

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage.
- L. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Labels:
  - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
  - 2. 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.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
  - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- T. Underground Line Warning Tape:
  1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway 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.
  2. Limit use of underground-line warning tape to direct-buried cables.
  3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Metal Tags:
  1. Secure using plenum-rated cable ties.
- V. Nonmetallic Preprinted Tags:
  1. Secure using plenum-rated cable ties.
- W. Write-on Tags:
  1. Place in a location with high visibility and accessibility.
  2. Secure using general-purpose cable ties.
- X. Baked-Enamel Signs:
  1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.
- Y. Laminated Acrylic or Melamine Plastic Signs:
  1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
  2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, use vinyl wraparound labels to identify the phase.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- H. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  1. Apply to exterior of door, cover, or other access.
  2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

- a. Controls with external control power connections.
- J. Arc Flash Warning Labeling: Self-adhesive labels. Secure on all:
  - a. Panelboards
- K. Operating Instruction Signs: Self-adhesive labels.
- L. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels:
  - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
  - 2. Outdoor Equipment: Laminated acrylic or melamine sign.
  - 3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Enclosed switches.
    - e. Enclosed controllers.
    - f. Push-button stations.
    - g. Contactors.
    - h. Monitoring and control equipment.

**END OF SECTION 260553**

**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.
- B. Scope of Study: Determine the short-circuit current available. Provide an analysis of all possible operating scenarios which will be or have been influenced by the proposed or completed additions or changes to the subject system.
- C. Procedure: The short-circuit study shall be performed in accordance with the recommended practices and procedures set forth in ANSI/IEEE standard 399 and the step-by-step procedures outlined in the short-circuit calculation chapters of IEEE standard 141 and ANSI/IEEE standard 242.
- D. Study Report: Results of the short-circuit study shall be summarized in a final report containing the following items:
  - 1. Basis, description, purpose and scope of the study.
  - 2. Listing of all equipment electrical equipment including rating (voltage, power, ampacity, short circuit rating, impedance) along with building room number.
  - 3. Tabulations of the data used to model the system components and a corresponding one-line diagram.
  - 4. Descriptions of the scenarios evaluated, and identification of the scenario used to evaluate equipment short-circuit ratings.
  - 5. Tabulations of equipment short-circuit ratings versus available fault duties. The tabulation shall identify percentages of rated short-circuit and clearly note equipment with insufficient ratings.
  - 6. Conclusions and recommendations.

**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 SUBMITTALS**

- A. Product Data:
  - 1. Submit the following after the approval of system protective devices submittals. Submittals may 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 Project Manager 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 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.
    - e. SKM Model

#### **1.6 QUALITY ASSURANCE**

- A. Study shall be performed using SKM Software.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. 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.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. 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 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. SKM.
- B. Comply with IEEE 399 and IEEE 551.
  1. Analytical features of power systems analysis software program shall have 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.

## 2.2 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 Project Manager's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of submittals for this Project.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the short-circuit study. Record 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. 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 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. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  9. Motor horsepower and NEMA MG 1 code letter designation.
  10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  11. 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.
  - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. 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.

**END OF SECTION 260573.13**

**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is 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 series-rated devices.
- B. Scope of Study: Determine protective device characteristics settings which provide a balance between equipment protection and selective device operation that is optimum for the electrical system. Provide an analysis of all possible operating scenarios which will be or have been influenced by the proposed or completed additions or changes to the subject system.
- C. Procedure: The coordination study shall be performed in accordance with the recommended practices and procedures set forth in ANSI/IEEE standard 399 and ANSI/IEEE standard 242. Protective device selection and settings shall comply with requirements of the *National Electric Code*.
- D. Study Report: Results of the coordination study shall be summarized in a final report containing the following items:
  - E. Basis, description, purpose and scope of the study and a corresponding one-line diagram.
  - F. Time-current curves demonstrating the coordination of time-over-current positive devices.
  - G. Tabulations of protective devices identifying circuit location, manufacturer, type, range of adjustment, IEEE device number, current transformer ratios, recommended settings or device size and referenced time-current current curve.
  - H. Conclusions and recommendations.

**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. 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 System 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 SUBMITTALS**

- A. Product Data
  - 1. Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
    - a. Coordination-study input data, including completed computer program input data sheets.
    - b. Study and equipment evaluation reports.
  - 2. 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 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.
    - g. SKM Model

#### **1.6 QUALITY ASSURANCE**

- A. Studies shall be performed using SKM Software.
- 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.
  - 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 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. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. SKM.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. 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.
  3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- 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. 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. Maximum demands from service meters.
  13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  14. Motor horsepower and NEMA MG 1 code letter designation.
  15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
  16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
  17. 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.
  - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. 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. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- K. 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.
- L. 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.
- M. 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.

### 3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

### **3.5 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.

### **3.6 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 260573.16**



**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is 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.
- B. Provide an Arc Flash Hazard Study for the electrical distribution system shown on the one line drawings. The intent of the Arc Flash Hazard Study is to determine hazards that exist at each major piece of electrical equipment shown on the one line drawing. This includes switchgear, switchboards, panelboards, motor control centers, PDUs, UPS, ATs, and transformers. The study will include creation of Arc Flash Hazard Warning Labels. These labels serve as a guide to assist technicians and others in the selection of proper Personal Protective Equipment when working around exposed and energized conductors. The electrical contractor will install the labels.

**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 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 may be in digital form:
  - 1. Arc-flash study input data, including completed computer program input data sheets.
  - 2. Arc-flash study report; signed, dated, and sealed by 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: 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 COMPUTER SOFTWARE DEVELOPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. SKM.
- B. Comply with IEEE 1584 and NFPA 70E.

- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.



## **2.2 ARC-FLASH STUDY REPORT CONTENT**

- A. Executive summary 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.

## **2.3 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 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.
- D. Label Examples:

 <b>WARNING</b>				 <b>DANGER</b>			
Arc Flash and Shock Hazard Appropriate PPE Required				Arc Flash and Shock Hazard Interaction Prohibited When Energized			
7'-0"	Flash Hazard Boundary			65'-0"	Flash Hazard Boundary		
5	Cal/cm2 Incident Energy at 1'-6"			300	Cal/cm2 Incident Energy at 1'-6"		
4160	Volts Shock Hazard When Cover is Removed			480	Volts Shock Hazard When Cover is Removed		
5'-0"	Limited Approach Boundary			3'-6"	Limited Approach Boundary		
2'-2"	Restricted Approach Boundary			1'-0"	Restricted Approach Boundary		
0'-7"	Prohibited Approach Boundary			0'-1"	Prohibited Approach Boundary		
Device ID:				Device ID:			
TWIN TOWERS SWITCH				MSB MAIN			
-				-			
Analysis Date: 09.25.13				Analysis Date: 09.25.13			
TRT VAULT				MSB MAIN			

1.

### 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 studies prior to starting the Arc-Flash Hazard Analysis or obtain results from another source.
  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, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- 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 Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. 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 and on side or rear covers with accessible live parts and hinged doors or removable plates 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 switchboard.
  3. Switchgear.
  4. Medium-voltage switch.
  5. Medium voltage transformers
  6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
  7. Panelboard and safety switch over 250 V.
  8. Applicable panelboard and safety switch under 250 V.
  9. Control panel.
  10. Motor controllers (starters and variable frequency drives).
  11. Disconnect and safety switches.
- 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 260573.19**

**SECTION 262316  
UTILITY SERVICE CONNECTION CABINET**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. The contractor shall furnish and install, where indicated, a free-standing, pad mounted utility service connection cabinet specified herein, and as shown on the contract drawings.

**1.2 REFERENCES**

- A. The utility service connection cabinet shall be designed, manufactured and tested in accordance with the latest applicable following standards:
  - 1. NEC
  - 2. UL Standard 1773

**1.3 SUBMITTALS – FOR REVIEW/APPROVAL**

- A. The following information shall be submitted to the Engineer:
  - 1. Front view elevation
  - 2. Plan view
  - 3. Single line
  - 4. Conduit entry/exit locations
  - 5. Assembly ratings including:
    - a. Short-circuit rating
    - b. Voltage
    - c. Continuous current
  - 6. Cable terminal sizes

**1.4 SUBMITTALS – FOR CONSTRUCTION**

- A. The following information shall be submitted for record purposes:
  - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
  - 2. Installation information.

**1.5 QUALIFICATIONS**

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

**1.6 REGULATORY REQUIREMENTS**

- A. The service connection cabinet shall be listed and labeled by accredited international third party source such as (ETL OR UL) to industry standard 1773.

**1.7 DELIVERY, STORAGE AND HANDLING**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

**1.8 OPERATION AND MAINTENANCE MANUALS**

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

A. AMP – American Midwest Power 1-800-328-8658

Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date in writing.

### **2.2 RATINGS**

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current 85,000 amperes symmetrical at rated voltage without cable lashing.

B. Voltage: 600V

C. Amperage: Rating to be as indicated on the drawings.

### **2.3 CONSTRUCTION**

A. The service connection cabinet shall be a rigid assembly consisting of a base made of die formed 12 gauge galvanized steel channels and frame members bolted together to form a rigid self supporting structure suitable for pad mount installation and shall include leveling provisions.

B. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed.

C. The assembly shall be provided with a palette skid that completely seals the bottom of the enclosure to prevent the forks of the lifting means from inadvertently causing shipping damage by entering the bottom of the enclosure.

### **2.4 BUS**

A. All bus bars shall be silver-plated copper or tin-plated aluminum. All phase and neutral bars shall be punched with 9/16" square holes on 2" centers horizontally and 1-3/4" centers vertically. Holes must be square to accept carriage bolt to facilitate one wrench installation.

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. Bus bars to be supported by a minimum of 2 insulators supports every 18" on center.

### **2.5 WIRING/TERMINATIONS**

A. Mechanical-type terminals shall be provided for all load terminations and be suitable for copper or aluminum cable rated for 75 degrees C and shall be dual rated to accept (1)#6-750MCM or (2)#6-300MCM per lug.

### **2.6 UTILITY METERING.**

A. Where indicated on the drawings, the service connection cabinet shall be provided with utility metering provisions behind a hinged sealable door. Bus work shall include provisions for mounting utility company current transformers as required by the utility company.

### **2.7 ENCLOSURES**

A. Outdoor NEMA 3R Enclosure

1. Outdoor enclosure shall meet applicable NEMA 3R UL requirements

2. Enclosure shall have a cross checked reinforced roof.

3. The enclosure shall be provided with galvanized pan formed side and rear covers bolted to the frame with tamperproof zinc plated bolts.

4. Doors over utility CT provisions shall have continuous hinges and provisions for padlocking.



5. All exterior and non galvanized interior steel surfaces of the service connection cabinet shall be properly cleaned and provided with an oven baked polyester powder coating paint applied electro-statically. Color and finish of the cabinet shall be transformer green.

**PART 3 EXECUTION**

**3.1 INSTALLATION**

- A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.

**END OF SECTION 262316**

**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

**1.3 DEFINITIONS**

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. MCCB: Molded-case circuit breaker.

**1.4 SUBMITTALS**

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details.
  - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
  - 3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
  - 4. Detail bus configuration, current, and voltage ratings.
  - 5. Short-circuit current rating of panelboards and overcurrent protective devices.
  - 6. 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. Key interlock scheme drawing and sequence of operations.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. 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.

## **1.6 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. Keys: Two spares for each type of panelboard cabinet lock.

## **1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

## **1.9 FIELD CONDITIONS**

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.

## **1.10 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 PANELBOARD COMMON REQUIREMENTS**

- A. 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.
- 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 PB 1.
- D. Comply with NFPA 70.
- E. Enclosures: Flush and Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Height: 84 inches maximum, line up tops of dissimilar sized panelboards mounted adjacent to each other.
  - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
  - 4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - a. Panels and Trim: galvanized 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..
- F. Incoming Mains:
1. Location: Top or Bottom, refer to electrical drawings.
  2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Terminations shall allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
  6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- I. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. ABB
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only, refer to electrical drawings.
- E. All Circuit-Breakers shall be Bolt-on type circuit breakers.

## 2.3 BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. ABB
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

## 2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. ABB
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.
    - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic Trip Circuit Breakers:
    - a. RMS sensing.
    - b. Field-replaceable rating plug or electronic trip.
    - c. Digital display of settings, trip targets, and indicated metering displays.
    - d. Multi-button keypad to access programmable functions and monitored data.
    - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    - f. Integral test jack for connection to portable test set or laptop computer.
    - g. Field-Adjustable Settings:
      - 1) Instantaneous trip.
      - 2) Long- and short-time pickup levels.

- 3) Long and short time adjustments.
- 4) Ground-fault pickup level, time delay, and I squared T response.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 6. Subfeed Circuit Breakers: Vertically mounted.
- 7. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
  - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units. Unless otherwise noted on the drawings.
  - i. Multipole units enclosed in a single housing with a single handle.
  - j. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
  - k. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

## 2.5 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407 and NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment,

raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.
- D. Equipment Mounting:
  - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
- J. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
  - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- L. Install filler plates in unused spaces.
- M. 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.
- N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

### **3.4 FIELD QUALITY CONTROL**

- A. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Tests and Inspections:
  - 1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Panelboards will be considered defective if they do not pass tests and inspections.

- D. Prepare test and inspection reports, including a certified report that identifies panelboards included. 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 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

**END OF SECTION 262416**



**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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Standard-grade receptacles, 125 V, 20 A.
  - 2. GFCI receptacles, 125 V, 20 A.
  - 3. Toggle switches, 120/277 V, 20 A.
  - 4. Occupancy sensors.
  - 5. Wall plates.

**1.3 DEFINITIONS**

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

**PART 2 - PRODUCTS**

**2.1 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 use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.

- E. 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 requirements in this Section.
- F. Devices for Owner-Furnished Equipment:
  1. Receptacles: Match plug configurations.
  2. Cord and Plug Sets: Match equipment requirements.
- G. 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 Essential Electrical System: Red.
- H. Wall Plate Color: For plastic covers, match device color.
- I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

## **2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton (Arrow Hart).
  2. Hubbell Incorporated; Wiring Device-Kellems.
  3. Leviton Manufacturing Co., Inc.
  4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:
  1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498 and FS W-C-596.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
  1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.
- D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
  1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Standards: Comply with UL 498.
  4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

## **2.3 GFCI RECEPTACLES, 125 V, 20 A**

- A. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
  1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
  2. Configuration: NEMA WD 6, Configuration 5-20R.
  3. Type: Feed through.
  4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.
- B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  2. Configuration: NEMA WD 6, Configuration 5-15R.
  3. Type: Feed through.
  4. Standards: Comply with UL 498 and UL 943 Class A.
  5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

## **2.4 TOGGLE SWITCHES, 120/277 V, 20 A**

- A. Single-Pole Switches, 120/277 V, 20 A:
1. Standards: Comply with UL 20 and FS W-S-896.
- B. Three-Way Switches, 120/277 V, 20 A:
1. Comply with UL 20 and FS W-S-896.
- C. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
1. Description: Factory-supplied key in lieu of switch handle.
  2. Standards: Comply with UL 20 and FS W-S-896.

## **2.5 OCCUPANCY SENSORS**

- A. Wall Sensor Light Switch, Passive Infrared:
1. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
  2. Standards: Comply with UL 20.
  3. Connections: Provisions for connection to BAS.
  4. Connections: Hard wired as specified on drawing.
  5. Connections: Wireless as specified on drawing.
  6. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
  7. Integral relay for connection to BAS, only as noted on drawing.
  8. Adjustable time delay of 20 minutes.
  9. Able to be locked to Automatic or Manual-On mode.
  10. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

## **2.6 WALL PLATES**

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. 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.
- C. Wet-Location, Weatherproof In-Use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## **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 comply with NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  - 6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  - 8. Tighten unused terminal screws on the device.
  - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
  - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. 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.

### **3.2 GFCI RECEPTACLES**

- A. Install non-feed-through GFCI receptacles.

### **3.3 IDENTIFICATION**

- A. Comply with Section 260553 "Identification for Electrical Systems."

- B. Identify each receptacle with panelboard identification and circuit number. Use preprinted tape label (PTouch) machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
- C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

### **3.4 FIELD QUALITY CONTROL**

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
  - 1. Test Instruments: Use instruments that comply with UL 1436.
  - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for 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.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

**END OF SECTION 262726**

**SECTION 262813  
FUSES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Cartridge fuses rated 600 V ac and less for use in the following:
    - a. Control circuits.
    - b. Enclosed switches.
  - 2. Spare-fuse cabinets.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
  - 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. Include the following:
  - 1. Ambient temperature adjustment information.
  - 2. Current-limitation curves for fuses with current-limiting characteristics.
  - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
  - 4. Coordination charts and tables and related data.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

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

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

## **1.6 FIELD CONDITIONS**

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Bussmann, an Eaton business.
  2. Edison; a brand of Bussmann by Eaton.
  3. Littelfuse, Inc.
  4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

### **2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type RK-5: 250 or 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, time delay.
  4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
  5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
  7. Type T: 250-V, zero- to 1200-A or 600-V, zero- to 800-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### **2.3 SPARE-FUSE CABINET**

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
  1. Size: Adequate for storage of spare fuses specified with 10 percent spare capacity minimum.
  2. Finish: Gray, baked enamel.
  3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
  4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 FUSE APPLICATIONS**

- A. Cartridge Fuses:
  - 1. Service Entrance: Class L, time delay.
  - 2. Feeders: Class RK1.
  - 3. Motor Branch Circuits: Class RK5, time delay.
  - 4. Large Motor Branch: Fuse type appropriate to conform to coordination study.
  - 5. Power Electronics Circuits: Fuse type appropriate to conform to coordination study.
  - 6. Other Branch Circuits: Fuse type appropriate to conform to coordination study.
  - 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

### **3.3 INSTALLATION**

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Project Manager.

### **3.4 IDENTIFICATION**

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

**END OF SECTION 262813**



**SECTION 262816  
ENCLOSED SWITCHES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Shunt trip switches.
  - 4. Enclosures.

**1.3 DEFINITIONS**

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

**1.4 SUBMITTALS**

- A. Product Data: For each type of enclosed switch, accessory, and component indicated. Include nameplate ratings, 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 5. 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. Provide in PDF electronic format.
- B. Shop Drawings: For enclosed switches.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include wiring diagrams for power, signal, and control wiring.

**1.5 CLOSEOUT DOCUMENTS**

- A. Operation and Maintenance Data: For enclosed switches to include in emergency, operation, and maintenance manuals.
  - 1. Include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches.
    - b. 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. Provide in PDF electronic format.

## **1.6 MAINTENANCE 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Fuse Pullers: Two for each size and type.

## **1.7 FIELD 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.

## **1.8 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One year(s) from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS**

- A. Source Limitations: Obtain enclosed switches, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches, 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 an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### **2.2 FUSIBLE SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. ABB.
  - 3. Siemens Industry, Inc., Energy Management Division.
  - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty:
  - 1. Single throw.
  - 2. Three pole.
  - 3. 240 or 600-V ac.
  - 4. 1200 A and smaller.
  - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
  - 6. 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. Provide as indicated on drawings.

### 2.3 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. ABB
  3. Siemens Industry, Inc., Energy Management Division.
  4. Square D; by Schneider Electric.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- 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. Lugs: Mechanical type, suitable for number, size, and conductor material.
  4. Service-Rated Switches: Labeled for use as service equipment. Provide as indicated on drawings.

### 2.4 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton.
  2. Bussman.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 240 or 600-V ac, amperage as indicated on drawings; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
  1. Oiltight key switch for key-to-test function.
  2. Oiltight red ON pilot light.
  3. Neutral lug; 100 percent rating.
  4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  5. Form C alarm contacts that change state when switch is tripped.
  6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
  7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
  8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
  9. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

10. Auxiliary Contact Kit: TwoNO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
11. Hookstick Handle: Allows use of a hookstick to operate the handle.
12. Lugs: Mechanical type, suitable for number, size, and conductor material.
13. Service-Rated Switches: Labeled for use as service equipment.

## **2.5 ENCLOSURES**

- A. Enclosed Switches: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel.
- C. Conduit Entry: Knock-outs for Type 1 and threaded hubs for Type 3R and Stainless Steel Type 4X.
- D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the dead front trim of the enclosure. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

### **3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS**

- A. Provide enclosures at installed locations with the following environmental ratings.
  1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  2. Outdoor Locations: NEMA 250, Type 3R Type 4X.
  3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 3R.

### **3.3 INSTALLATION**

- A. Coordinate layout and installation of switches and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

### **3.4 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.

### **3.5 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
    - h. Verify correct phase barrier installation.
    - i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
- C. Enclosed switches will be considered defective if they do not pass tests and inspections.

### **3.6 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 "Coordination Studies."

**END OF SECTION 262816**

**SECTION 262913  
MANUAL MOTOR CONTROLLERS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Manual motor controllers.
  - 2. Enclosures.
  - 3. Accessories.
  - 4. Identification.

**1.3 DEFINITIONS**

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
  - 3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
  - 4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Product Schedule: List the following for each enclosed controller:
  - 1. Each installed controller type.
  - 2. NRTL listing.
  - 3. Factory-installed accessories.
  - 4. Nameplate legends.
  - 5. SCCR of integrated unit.
  - 6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.

- a. Listing document proving Type 2 coordination.

## **1.5 CLOSEOUT DOCUMENTATION**

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
  - 1. Include the following:
    - a. Routine maintenance requirements for magnetic controllers and installed components.
    - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
    - c. Manufacturer's written instructions for setting field-adjustable overload relays.
    - 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 switch settings for motor-running overload protection suit actual motors to be protected.

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

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; connect factory-installed space heaters to temporary electrical service.

## **1.7 FIELD CONDITIONS**

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

## **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 use.
- B. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

### **2.2 MANUAL MOTOR CONTROLLERS**

- A. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" lockable toggle or push-button action; marked to show whether unit is off, on, or tripped.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Eaton.
    - b. ABB
    - c. Rockwell Automation, Inc.
    - d. Siemens Industry, Inc., Energy Management Division.
    - e. Square D; by Schneider Electric.
  - 2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; melting alloy type.
4. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
5. Pilot Light: Red.

### **2.3 ENCLOSURES**

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.

### **2.4 IDENTIFICATION**

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
  1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis."

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

### **3.2 INSTALLATION**

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. 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.
- E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

### **3.3 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
  2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.



- c. Inspect anchorage, alignment, and grounding.
  - d. Verify the unit is clean.
  - e. Inspect contactors:
    - 1) Verify mechanical operation.
    - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
  - f. Motor-Running Protection:
    - 1) Verify overload element rating is correct for its application.
    - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
- B. Motor controller will be considered defective if it does not pass tests and inspections.

### **3.5 SYSTEM FUNCTION TESTS**

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.
  - 1. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
  - 2. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

**END OF SECTION 262913**

**SECTION 264313**  
**SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

**1.3 DEFINITIONS**

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

**1.5 CLOSEOUT DOCUMENTS**

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

**1.6 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 GENERAL SPD REQUIREMENTS**

- A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

## 2.2 SERVICE ENTRANCE SUPPRESSOR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. Current Technologies, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Liebert; a brand of Vertiv.
  - 5. Schneider Electric USA, Inc.
  - 6. Siemens Industry, Inc., Energy Management Division.
  - 7. SSI, an ILSCO Company.
- B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1
  - 1. SPDs with the following features and accessories:
    - a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    - b. Include LED indicator lights for power and protection status.
    - c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
    - d. Six Digit Surge counter.
    - e. Integral Disconnect switch
    - f. Constructed with copper bus.
- C. Comply with UL 1283.
- D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 320 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with [480Y/277 V] [208Y/120 V], three-phase, four-wire circuits shall not exceed the following:
  - 1. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
  - 2. Line to Ground: [1200 V for 480Y/277 V] [1200 V for 208Y/120 V].
  - 3. Line to Line: [2000 V for 480Y/277 V] [1000 V for 208Y/120 V].
- F. SCCR: Equal or exceed 200 kA.
- G. Nominal Rating: 20 kA.

## 2.3 PANEL SUPPRESSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eaton.
  - 2. Current Technologies, Inc.
  - 3. Leviton Manufacturing Co., Inc.
  - 4. Liebert; a brand of Vertiv.
  - 5. Schneider Electric USA, Inc.
  - 6. Siemens Industry, Inc., Energy Management Division.
  - 7. SSI, an ILSCO Company.
- B. SPDs: Comply with UL 1449, Type 3.
  - 1. Include LED indicator lights for power and protection status.
  - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 120 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Comply with UL 1283.
- E. Protection modes and UL 1449 VPR for grounded wye circuits with [480Y/277 V] [208Y/120 V], three-phase, four-wire circuits shall not exceed the following:
  1. Line to Neutral: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
  2. Line to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
  3. Neutral to Ground: [1200 V for 480Y/277 V] [700 V for 208Y/120 V].
  4. Line to Line: [2000 V for 480Y/277 V] [1200 V for 208Y/120 V]
- F. SCCR: Equal or exceed 100 kA.
- G. Inominal Rating: 20 kA.

## 2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.

## 2.5 CONDUCTORS AND CABLES

- A. Power Wiring: Same size or larger as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
  2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  2. Inspect anchorage, alignment, grounding, and clearances.
  3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.3 STARTUP SERVICE**

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

**3.4 DEMONSTRATION**

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

**END OF SECTION 264313**

**SECTION 265119  
LED 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.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section includes:
  - 1. Interior LED luminaries, lamps, and drivers.
  - 2. Luminaire supports.

**1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

**1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  - 1. Provide a list of all luminaire types used on Project; use ANSI and manufacturers' codes.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Drivers: One for every 10 of each type installed. Furnish at least one of each type.
  - 2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

## **1.7 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- E. Rated lamp life of 35,000 (minimum) hours.
- F. Drivers shall be dimmable from 100 percent to 10 percent of maximum light output with 0-10V input signal.
- G. Driver shall be accessible when ceiling is finished without the use of an access panel.

## **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## **1.9 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) minimum from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide product or its listed engineer's approved equivalent product indicated on drawings.

### **2.2 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Recessed luminaires shall comply with NEMA LE 4.
- C. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

### **2.3 MATERIALS**

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.
- B. Diffusers:
  - 1. Prismatic
  - 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- C. Housings: Refer to Lighting Fixture Schedule on Drawings.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install drivers for each luminaire.
- D. Supports:
  - 1. All fixtures to be supported securely from building structure and/or walls and the responsibility for mounting same shall be that of this Contractor.
    - a. Where surface mounted fixtures are mounted from "lay-in" type ceilings, the fixtures shall be supported independent of respective lay-in panel channel support system and fastened to the building structural system. Support from all 4-corners.
    - b. Wall mounted fixtures to have additional 1/4" toggle bolt (or equivalent) support at each end of module.
  - 2. Sized and rated for luminaire weight.
  - 3. Able to maintain luminaire position after cleaning.
  - 4. Provide support for luminaire without causing deflection of ceiling or wall.
  - 5. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
  - 1. Attached to ceiling structural members at all 4-corners around circumference of luminaire.
  - 2. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
  - 1. Attached using through bolts and backing plates on either side of wall.
  - 2. Do not attach luminaires directly to gypsum board for structural support.
- G. Suspended Luminaires:
  - 1. Ceiling Mount Options:
    - a. Two 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length or as specified on drawings.
    - b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 10 feet in length or as specified on drawings.
    - c. Hook mount.



2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
  2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### **3.3 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### **3.5 STARTUP SERVICE**

- A. Comply with requirements for startup of lighting controls for specialty lighting and lighting controls.

### **3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  3. Adjust the aim of luminaires in the presence of the Architect

**END OF SECTION 265119**

**SECTION 265213  
EMERGENCY AND EXIT LIGHTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Emergency lighting units.
  - 2. Exit signs.
  - 3. Luminaire supports.

**1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Lumen: Measured output of lamp and luminaire, or both.
- E. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.4 SUBMITTALS**

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
  - 1. Include data on features, accessories, and finishes.
  - 2. Include physical description of the unit and dimensions.
  - 3. Battery and charger for light units.
  - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

**1.5 SUBMITTALS**

- A. Qualification Data: For testing laboratory providing photometric data for luminaires.
- B. Product Certificates: For each type of luminaire.

**1.6 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

## **1.7 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. Drivers: One for every 10 of each type and rating installed. Furnish at least one of each type.
  - 2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
  - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
  - 4. Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
  - 5. Self-contained/unitized fixture: One complete replacement for every 10 luminaires provided.

## **1.8 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

## **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## **1.10 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 5 year(s) minimum from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Power Unit Batteries: Five years minimum from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.

- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
  - 1. Emergency Connection: Operate one driver continuously at an output of minimum 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
  - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects driver from battery, and battery is automatically recharged and floated on charger.
  - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
    - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
    - c. Humidity: More than 95 percent (condensing).
    - d. Altitude: Exceeding 3300 feet.
  - 4. Nightlight Connection: Operate driver continuously at 40 percent minimum of rated light output.
  - 5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 6. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - 7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  - 8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.2 EMERGENCY LIGHTING

- A. Refer to Electrical Drawings for interior luminaire schedule.

## 2.3 MATERIALS

- A. Metal Parts:
  - 1. Free of burrs and sharp corners and edges.
  - 2. Sheet metal components shall be steel unless otherwise indicated.
  - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
  - 1. Smooth operating, free of light leakage under operating conditions.
  - 2. Designed to permit relamping without use of tools.
  - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:

1. Prismatic glass or Prismatic acrylic.
  2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
1. Extruded aluminum housing and heat sink.
  2. Painted finish.

#### **2.4 METAL FINISHES**

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

#### **2.5 LUMINAIRE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  1. Sized and rated for luminaire and emergency power unit weight.
  2. Able to maintain luminaire position when testing emergency power unit.
  3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
  4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  1. Attached to structural members in walls.
  2. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
  1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
  4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- G. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
  2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
  3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

### **3.3 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

### **3.5 STARTUP SERVICE**

- A. Perform startup service:
1. Charge emergency power units and batteries minimum of 24 hours and conduct 90 minute discharge test.

### **3.6 ADJUSTING**

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:
1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
    - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

**END OF SECTION 265213**

**SECTION 265613  
LIGHTING POLES AND STANDARDS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Poles and accessories for support of luminaires.

**1.3 DEFINITIONS**

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete luminaire.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

**1.4 SUBMITTALS**

- A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting and attachment details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of poles and pole accessories.
  - 4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
  - 5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
  - 6. Method and procedure of pole installation. Include manufacturer's written installations.

**1.5 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for foundation testing.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
  - 1. Warranty Period: Minimum of Five years from date of Substantial Completion.
  - 2. Warranty Period for Corrosion Resistance: Minimum of Five years from date of Substantial Completion.
  - 3. Warranty Period for Color Retention: Minimum of Five 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 pole foundation and pole power system.
- B. Structural Characteristics: Comply with AASHTO LTS-6-M.
- C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.
- D. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.
- E. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.
- F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
  - 1. Basic wind speed for calculating wind load for poles 50 feet high or less is 90 mph Insert value from AASHTO LTS-6-M for this Project.
    - a. Wind Importance Factor: 1.0.
    - b. Minimum Design Life: 25 years.
    - c. Velocity Conversion Factor: 1.0.
- G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.
- H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

### 2.2 ALUMINUM POLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Lighting, an Eaton business.
  - 2. H.E. Williams.
  - 3. Hubbell Incorporated.
  - 4. KIM Lighting.
  - 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
  - 6. LSI Industries.
  - 7. Valmont Industries
  - 8. Stresscrete Group
- B. Poles: Seamless, extruded structural tube complying with ASTM B 221, Alloy 6061-T6, with access handhole in in pole wall.
  - 1. Shape: Square, straight
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Mast Arms: Aluminum type, continuously welded to pole attachment plate. Material and finish same as plate.
- D. Brackets for Luminaires: Detachable, cantilever, without underbrace.



1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adaptor, then bolted together with stainless-steel bolts.
  2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- E. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- F. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- G. Fasteners: Stainless steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
  2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
- H. Handhole: Rectangular shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- J. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
  2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
  3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
  4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
- K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
  2. Powder coat shall comply with AAMA 2604.
    - a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    - b. Color: As selected by Architect from manufacturer's full range.

## 2.3 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

## 2.4 MOUNTING HARDWARE

- A. Anchor Bolts: Manufactured to ASTM F 1554, Grade 55, with a minimum yield strength of 55,000 psi.
1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.

- 2. Threading: Uniform National Coarse, Class 2A.
- B. Nuts: ASTM A 563, Grade A, Heavy-Hex
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.
- C. Washers: ASTM F 436, Type 1.
  - 1. Galvanizing: Hot dip galvanized according to ASTM A 153, Class C.
  - 2. Two washers provided per anchor bolt.

## **2.5 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 unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 POLE FOUNDATION**

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123 M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

### **3.3 POLE INSTALLATION**

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
  - 1. Fire Hydrants and Water Piping: 60 inches.
  - 2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
  - 3. Trees: 15 feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
  3. Install base covers unless otherwise indicated.
  4. Use a short piece of 1/2 -inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.
- F. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

### **3.4 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum using insulating fittings or treatment.
- B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

### **3.5 GROUNDING**

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
1. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

### **3.6 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.7 FIELD QUALITY CONTROL**

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Inspect poles for nicks, mars, dents, scratches, and other damage.
  2. System function tests.

**END OF SECTION 265613**

**SECTION 265619  
LED EXTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Division 26 Common Work Results for Electrical and Common Electrical Materials and Methods section apply to work specified in this is section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
- B. Related Requirements:
  - 1. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

**1.3 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.4 SUBMITTALS**

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
    - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
    - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
  - 6. Wiring diagrams for power, control, and signal wiring.
  - 7. Photoelectric relays.
  - 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.
  - 1. Provide a manufacturers cutsheets including replacement parts list, color temperature, lumen output, and optical pattern for all types used on Project. Use ANSI and manufacturers' codes.
  - 2. Include all manufacturers' warranty information.

### **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. Drivers: One for every 10 of each type and rating installed. Furnish at least one of each type.
  - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 10 of each type and rating installed. Furnish at least one of each type.

### **1.7 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

### **1.9 FIELD CONDITIONS**

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

### **1.10 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 5 year(s) minimum from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Products: Subject to compliance with requirements, provide product or its listed engineer's approved equivalent product indicated on drawings.

### **2.2 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. CRI of minimum 80. CCT of 4000 K.
- F. L70 lamp life of 50,000 hours.
- G. Dimmable from 100 percent to 10 percent of maximum light output.
- H. Internal driver.
- I. Retain "In-line Fusing" Paragraph below when an integral fuse is desired. Coordinate with the Exterior Luminaire Schedule on Drawings.
- J. In-line Fusing: Single fuse for 120V & 277V and two fuses for 208V and 480V on the primary for each luminaire.

### **2.3 MATERIALS**

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Diffusers:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- F. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  - 2. Provide filter/breather for enclosed luminaires.

### **2.4 FINISHES**

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
  - a. Color: Determined by Architect.

## **2.5 LUMINAIRE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Comply with NECA 1.
- B. Install drivers for each luminaire.
- C. Fasten luminaire to structural support.
- D. Supports:
  1. Sized and rated for luminaire weight.
  2. Able to maintain luminaire position after cleaning and relamping.
  3. Support luminaires without causing deflection of finished surface.
  4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
  1. Attached to structural members in walls.
- F. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- G. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- H. Coordinate layout and installation of luminaires with other construction.
- I. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### **3.3 CORROSION PREVENTION**

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems."

### **3.4 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### **3.5 FIELD QUALITY CONTROL**

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
  - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the IES testing guide(s).
  - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### **3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

**END OF SECTION 265619**



**SECTION 284621  
ADDRESSABLE FIRE-ALARM 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. Addressable fire-alarm system.
  - 2. Fire-alarm control unit (FACU).
  - 3. Manual fire-alarm boxes.
  - 4. System smoke detectors.
  - 5. Carbon monoxide detectors.
  - 6. Heat detectors.
  - 7. Fire-alarm notification appliances.
  - 8. Fire-alarm remote annunciators.
  - 9. Fire-alarm addressable interface devices.
  - 10. Digital alarm communicator transmitters (DACTs).
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for magnetic door holders that release in response to fire-alarm outputs.
  - 2. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for cables and conductors for fire-alarm systems.

**1.3 DEFINITIONS.**

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- E. NICET: National Institute for Certification in Engineering Technologies.
- F. PC: Personal computer.
- G. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
  - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
  - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

**1.4 ACTION SUBMITTALS**

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  4. Annunciator panel details as required by authorities having jurisdiction.
  5. Detail assembly and support requirements.
  6. Include voltage drop calculations for notification-appliance circuits.
  7. Include battery-size calculations.
  8. Include input/output matrix.
  9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  10. Include performance parameters and installation details for each detector.
    - a. Locate detectors in accordance with manufacturer's written instructions.
  11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
  2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
  3. Indicate audible appliances required to produce square wave signal per NFPA 72.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Qualification Statements: For Installer.
- C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  1. Include the following and deliver copies to authorities having jurisdiction:
    - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Record copy of site-specific software.
    - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

- 1) Equipment tested.
  - 2) Frequency of testing of installed components.
  - 3) Frequency of inspection of installed components.
  - 4) Requirements and recommendations related to results of maintenance.
  - 5) Manufacturer's user training manuals.
  - h. Manufacturer's required maintenance related to system warranty requirements.
  - i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On USB media and approved online or cloud solution.
  3. Device address list.
  4. Printout of software application and graphic screens.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
  3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  4. Detector Bases: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  5. Keys and Tools: One extra set for access to locked or tamperproofed components.
  6. Audible and Visual Notification Appliances: One of each type installed.
  7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
  2. Installation must be by personnel certified by NICET as fire-alarm Level IV technician.
  3. Obtain certification by NRTL in accordance with NFPA 72.
  4. Licensed or certified by authorities having jurisdiction.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Notifier; by Honeywell
  2. Edwards Systems Technologies
  3. Siemens Industry, Inc., Fire Safety Division.
  4. Simplex, by Johnson Controls

- B. Description:
  - 1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.
- C. Performance Criteria:
  - 1. Regulatory Requirements:
    - a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
  - 2. General Characteristics:
    - a. Automatic sensitivity control of certain smoke detectors.
    - b. Fire-alarm signal initiation must be by one or more of the following devices and systems:
      - 1) Manual stations.
      - 2) Heat detectors.
      - 3) Smoke detectors.
      - 4) Carbon monoxide detectors.
      - 5) Automatic sprinkler system water flow.
      - 6) Fire-extinguishing system operation.
      - 7) Fire standpipe system.
    - c. Fire-alarm signal must initiate the following actions:
      - 1) Continuously operate alarm notification appliances.
      - 2) Identify alarm and specific initiating device at FACU and remote annunciators.
      - 3) Transmit alarm signal to remote alarm receiving station.
      - 4) Unlock electric door locks in designated egress paths.
      - 5) Release fire and smoke doors held open by magnetic door holders.
      - 6) Recall elevators to primary or alternate recall floors.
      - 7) Activate elevator power shunt trip.
      - 8) Record events in system memory.
      - 9) Record events by system printer.
      - 10) Indicate device in alarm on graphic annunciator.
    - d. Supervisory signal initiation must be by one or more of the following devices and actions:
      - 1) Valve supervisory switch.
      - 2) Elevator shunt-trip supervision.
      - 3) Independent fire-detection and -suppression systems.
      - 4) Zones or individual devices have been disabled.
      - 5) FACU has lost communication with network.
    - e. System trouble signal initiation must be by one or more of the following devices and actions:
      - 1) Open circuits, shorts, and grounds in designated circuits.
      - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
      - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
      - 4) Loss of primary power at FACU.
      - 5) Ground or single break in internal circuits of FACU.
      - 6) Abnormal ac voltage at FACU.
      - 7) Break in standby battery circuitry.
      - 8) Failure of battery charging.
      - 9) Abnormal position of switch at FACU or annunciator.
    - f. System Supervisory Signal Actions:
      - 1) Initiate notification appliances.
      - 2) Identify specific device initiating event at FACU and remote annunciators.
      - 3) Record event on system printer.

- 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
- 5) Transmit system status to building management system.
- 6) Display system status on graphic annunciator.
- g. Network Communications:
  - 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
  - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
- h. System Printer:
  - 1) Printer must be listed and labeled as integral part of fire-alarm system.
- i. Document Storage Box:
  - 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
  - 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
  - 3) Color: Red powder-coat epoxy finish.
  - 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
  - 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

## 2.2 FIRE-ALARM CONTROL UNIT (FACU)

- A. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- B. Performance Criteria:
  1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
  2. General Characteristics:
    - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
    - b. Include real-time clock for time annotation of events on event recorder and printer.
    - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
    - d. FACU must be listed for connection to central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.
    - f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
      - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
    - g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
      - 1) Annunciator and Display: LCD, 40 characters, minimum.
      - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.

- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, three line(s) of 40 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1) Pathway Class Designations: NFPA 72, Class B
  - 2) Pathway Survivability: Level 0
  - 3) Install no more than 50 addressable devices on each signaling-line circuit.
  - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Serial Interfaces:
  - 1) One dedicated RS 485 port for central-station operation using point ID DACT.
  - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - 3) One USB port for PC configuration.
- k. Smoke-Alarm Verification:
  - 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
  - 2) Activate approved "alarm-verification" sequence at FACU and detector.
  - 3) Record events by system printer.
  - 4) Sound general alarm if alarm is verified.
  - 5) Cancel FACU indication and system reset if alarm is not verified.
- l. Notification-Appliance Circuit:
  - 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
  - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
  - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- m. Elevator Recall: Initiate by one of the following alarm-initiating devices:
  - 1) Elevator lobby detectors except lobby detector on designated floor.
  - 2) Smoke detectors in elevator machine room.
  - 3) Smoke detectors in elevator hoistway.
- n. Elevator controller must be programmed to move cars to alternate recall floor if lobby detectors located on designated recall floors are activated.
- o. Water-flow alarm connected to sprinkler in elevator shaft and elevator machine room must shut down elevators associated with location without time delay.
  - 1) Water-flow switch associated with sprinkler in elevator pit may have delay to allow elevators to move to designated floor.
- p. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls must be connected to fire-alarm system.
- q. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- r. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.

- 1) Allow application of, and evacuation signal to, indicated number of zones and simultaneously allow voice paging to other zones selectively or in combination.
  - 2) Programmable tone and message sequence selection.
  - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
  - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- s. Status Annunciator: Indicate status of various voice/alarm speaker zones and status of firefighters' two-way telephone communication zones.
  - t. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
  - u. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, must be powered by 24 V(dc) source.
  - v. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
  - w. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
  - x. Batteries:[Sealed lead calcium
- C. Accessories:
1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

## 2.3 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Double-action mechanism requiring two actions to initiate alarm, plastic-rod pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
  2. Station Reset: Key- or wrench-operated switch.
  3. Able to perform at up to 90 percent relative humidity at 90 deg F
  4. Material: Manual stations made of Lexan polycarbonate.
  5. Able to be used in indoor areas.

## 2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
1. Performance Criteria:
    - a. Regulatory Requirements:
      - 1) NFPA 72.
      - 2) UL 268.
    - b. General Characteristics:
      - 1) Detectors must be four-wire type.
      - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - a) Primary status.
  - b) Device type.
  - c) Present average value.
  - d) Present sensitivity selected.
  - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition[ and individually adjustable for sensitivity by FACU.
- 11) Multiple levels of detection sensitivity for each sensor.

## 2.5 CARBON MONOXIDE DETECTORS

- A. Description: Carbon monoxide detector listed for connection to fire-alarm system.
- B. Performance Criteria:
  1. Regulatory Requirements:
    - a. NFPA 72
    - b. NFPA 720.
    - c. UL 2075.
  2. General Characteristics:
    - a. Mounting: Adapter plate for outlet box mounting.
    - b. Testable by introducing test carbon monoxide into sensing cell.
    - c. Detector must provide alarm contacts and trouble contacts.
    - d. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
    - e. Locate, mount, and wire in accordance with manufacturer's written instructions.
    - f. Provide means for addressable connection to fire-alarm system.
    - g. Test button simulates alarm condition.

## 2.6 HEAT DETECTORS

- A. Fixed-Temperature-Type Heat Detectors:
  1. Performance Criteria:



- a. Regulatory Requirements:
  - 1) NFPA 72.
  - 2) UL 521.
- b. General Characteristics:
  - 1) Actuated by temperature that exceeds fixed temperature of 190 deg F.
  - 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
  - 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
  - 4) Detector must have functional humidity range of 10 to 90 percent.
  - 5) Color: White.

## 2.7 FIRE-ALARM NOTIFICATION APPLIANCES

- A. Fire-Alarm Audible Notification Appliances:
  - 1. Description: Horns, bells, or other notification devices that cannot output voice messages.
  - 2. Performance Criteria:
    - a. Regulatory Requirements:
      - 1) NFPA 72.
    - b. General Characteristics:
      - 1) Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
      - 2) Chimes, Low-Level Output: Vibrating type, 75 dB(A-weighted) minimum rated output.
      - 3) Chimes, High-Level Output: Vibrating type, 81 dB(A-weighted) minimum rated output.
      - 4) Sounders, High Volume 24 V(dc): Less than 6 mA of alarm current.
      - 5) Sounders, Low Volume 24 V(dc): Less than 4 mA of alarm current.
      - 6) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
      - 7) ISO Temporal 3 Evacuation Tone: 90 plus or minus 4 dB(A-weighted) at 24 V.
      - 8) ISO Temporal 3 Alert Tone: 95 plus or minus 5 dB(A-weighted) at 24 V.
      - 9) AS2220 Evacuation Tone: 93 plus or minus 4 dB(A-weighted) at 24 V.
      - 10) AS2220 Alert Tone: 93 plus or minus 5 dB(A-weighted) at 24 V.
      - 11) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
      - 12) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- B. Fire-Alarm Visible Notification Appliances:
  - 1. Performance Criteria:
    - a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
  - a) 15/30/75/110 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, as selected by Architect.

## 2.8 EMERGENCY RESPONDER RADIO COVERAGE SYSTEM

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Description: Emergency responder radio coverage systems use a combination of bidirectional amplifiers and distributed antenna systems to boost signals for sustaining two-way radio communications throughout a facility, including stairwells, underground tunnels, parking garages, and other challenging areas.

C. Performance Criteria:

1. Regulatory Requirements:

- a. In accordance with NFPA 72, emergency responder radio coverage systems must be designed, installed, and maintained in accordance with NFPA 1221.

2. General Characteristics:

- a. Where emergency responder radio coverage system is used in lieu of two-way in-building wired emergency communications system, it must have pathway survivability of Level 1, 2, or 3 as defined in NFPA 72.
- b. Where leaky feeder cable is used as antenna, it must neither be required to be installed in metal raceway nor meet survivability requirements.
- c. Feeder and riser coaxial cables must be rated as plenum cables.
- d. Feeder coaxial cables must be connected to riser coaxial cables using hybrid coupler devices of value determined by overall design.
- e. Where emergency responder radio coverage system is used in lieu of two-way in-building wired emergency communications system, design of system must be approved by authorities having jurisdiction. Riser coaxial cables must be rated as riser cables and routed through 2-hour-rated enclosure.
- f. Connection between riser and feeder coaxial cables must be made within 2-hour-rated enclosure, and passage of feeder cable in and out of 2-hour-rated enclosure must be firestopped to 2-hour ratings.

## 2.9 FIRE-ALARM REMOTE ANNUNCIATORS

### A. Performance Criteria:

#### 1. Regulatory Requirements:

- a. NFPA 72.

#### 2. General Characteristics:

- a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
  - 1) Mounting: Flush cabinet, NEMA 250, Type 1.
- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

## 2.10 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

### A. Performance Criteria:

#### 1. Regulatory Requirements:

- a. NFPA 72.

#### 2. General Characteristics:

- a. Include address-setting means on module.
- b. Store internal identifying code for control panel use to identify module type.
- c. Listed for controlling HVAC fan motor controllers.
- d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
- e. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall.
  - 1) Allow control panel to switch relay contacts on command.
  - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.
- f. Control Module:
  - 1) Operate notification devices.
  - 2) Operate solenoids for use in sprinkler service.

## 2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

### A. Performance Criteria:

1. Regulatory Requirements:
  - a. NFPA 72.
2. General Characteristics:
  - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
  - b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture two telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
  - c. Local functions and display at DACT must include the following:
    - 1) Verification that both telephone lines are available.
    - 2) Programming device.
    - 3) LED display.
    - 4) Manual test report function and manual transmission clear indication.
    - 5) Communications failure with central station or FACU.
  - d. Digital data transmission must include the following:
    - 1) Address of alarm-initiating device.
    - 2) Address of supervisory signal.
    - 3) Address of trouble-initiating device.
    - 4) Loss of ac supply.
    - 5) Loss of power.
    - 6) Low battery.
    - 7) Abnormal test signal.
    - 8) Communication bus failure.
  - e. Secondary Power: Integral rechargeable battery and automatic charger.
  - f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

### 3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before other trades have completed cleanup must be replaced.
  - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Equipment Floor and Wall Mounting: Install FACU on finished floor.
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
- D. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
  - 2. Mount manual fire-alarm box on background of contrasting color.
  - 3. Operable part of manual fire-alarm box must be between 42 and 48 inch) above floor level. Devices must be mounted at same height unless otherwise indicated.
- E. Smoke- and Heat-Detector Spacing:
  - 1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. Smooth ceiling spacing must not exceed 30 ft.
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
  - 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- F. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.

- G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.
- H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within dwelling or suite, they must be connected so that operation of smoke alarm causes alarm in smoke alarms to sound.
- I. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- J. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- L. Device Location-Indicating Lights: Locate in public space near device they monitor.

### 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.
  - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

### 3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
  - 1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Exposed EMT must be painted red enamel.

### 3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  - 1. Electronically locked doors and access gates.
  - 2. Alarm-initiating connection to elevator recall system and components.
  - 3. Supervisory connections at valve supervisory switches.
  - 4. Supervisory connections at elevator shunt-trip breaker.

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in location visible from FACU.

### 3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

### 3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
  - 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.

2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
  4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
  5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
  6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify 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. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.

### 3.12 MAINTENANCE

- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

### 3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.



- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

**END OF SECTION 284621**

**SECTION 311000  
SITE CLEARING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
  - 2. Removing existing trees, shrubs, groundcovers, plants and grass.
  - 3. Clearing and grubbing.
  - 4. Stripping and stockpiling topsoil.
  - 5. Removing above- and below-grade site improvements.
  - 6. Disconnecting, capping or sealing, and removing site utilities.
  - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections include the following:
  - 1. Division 31 Section "Earthwork for Utilities" for soil materials, excavating, backfilling, and site grading.
  - 2. Division 32 Section "Lawn and Grasses" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.

**1.3 DEFINITIONS**

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1/2 inch in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

**1.4 MATERIAL OWNERSHIP**

- A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

**1.5 SUBMITTALS**

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings, according to Division 01 Section "Project Record Documents," identifying and accurately locating capped utilities and other subsurface structural, electrical, and mechanical conditions.

**1.6 QUALITY ASSURANCE**

- A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

## **1.7 PROJECT CONDITIONS**

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

## **PART 2 - PRODUCTS**

### **2.1 SOIL MATERIALS**

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earthwork for Utilities."
  - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### **3.2 TREE PROTECTION**

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within fenced area.
  - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
  - 3. Maintain fenced area free of weeds and trash.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
  - 1. Cover exposed roots with burlap and water regularly.
  - 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  - 3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
  - 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
2. Replace trees that cannot be repaired and restored to full-growth status, as determined by Architect.

### **3.3 UTILITIES**

- A. Contractor to arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
  1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  1. Arrange with utility companies to shut off indicated utilities.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  1. Notify Architect not less than two days in advance of proposed utility interruptions.
  2. Do not proceed with utility interruptions without Architect's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.

### **3.4 CLEARING AND GRUBBING**

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.
  1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
  3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
  4. Use only hand methods for grubbing within tree protection zone.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

### **3.5 TOPSOIL STRIPPING**

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
  1. Remove subsoil and nonsoil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  1. Limit height of topsoil stockpiles to 72 inches.
  2. Do not stockpile topsoil within tree protection zones.
  3. Legally dispose of excess topsoil.

### **3.6 SITE IMPROVEMENTS**

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

**3.7 DISPOSAL**

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

**END OF SECTION 311000**

**SECTION 312000  
EARTHWORK FOR UTILITIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SECTION INCLUDES**

- A. Preparing of subgrade for building foundations and slabs.
- B. Removal and disposal of excess excavation resulting from construction.
- C. Preparing and grading subgrades for slabs-on-grade, walks, drives, and parking lots.
- D. Subbase course for walks and pavements.
- E. Excavating and backfilling trenches for utilities and utility's structures.

**1.3 RELATED SECTIONS**

- A. Division 31 - Site Clearing.
- B. Division 32 - Hot-mix asphalt paving.
- C. Division 32 - Landscaping.
- D. Division 23 - Mechanical.
- E. Division 26 - Electrical.

**1.4 DEFINITIONS**

- A. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.
- B. Unauthorized Excavation: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.
  - 1. Under footings or foundation bases, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Architect.
  - 2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect.
- C. Additional Excavation: When excavation has reached required subgrade elevations, notify Testing Agency, who will make an inspection of conditions.
  - 1. If suitable bearing is not encountered at the elevations indicated on Drawings for foundations, do not proceed further until instructions are given and necessary measurements made for purpose of establishing additional volume of excavation.
- D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.
- E. Structure: Buildings, foundations, and slabs.
- F. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.
- G. Subbase Course: The layer placed between the subgrade and base course in a paving system or the layer placed between the subgrade and surface of a pavement or walk.
- H. Premium Backfill: Trench backfill above the pipe cover where piping is under pavement areas.
- I. Base Course: The layer placed between the subbase and surface pavement in a paving system.
- J. Bedding: Trench backfill underneath the pipe.
- K. Pipe Cover: Trench backfill placed beside and over the pipe in a trench.

- L. Regular Backfill: Trench backfill placed over pipe cover where piping is under non-paved areas.
- M. Utilities: On-site underground pipes, conduits, ducts and cables, as well as underground services within building lines.

### **1.5 SUBMITTALS**

- A. Test Reports: Submit the following reports directly to Architect from the testing services.
  - 1. Test reports on borrow material.
  - 2. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
  - 3. Field reports; in-place soil density tests.
  - 4. Bearing soil inspections for footings.
  - 5. Compaction tests for controlled backfill material.
- B. Certification: Submit certification signed by Contractor and foundation drainage system installer that installed materials, conform to specified requirements and system was successfully checked and tested prior to covering with filtering and drainage fill.
- C. Photographs of existing adjacent structures and site improvements.

### **1.6 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
- B. Testing and Inspection Service:
  - 1. Employ and pay for a qualified independent geotechnical testing and inspection laboratory to perform soil testing and inspection service during earthwork operations.
  - 2. Testing Laboratory Qualifications: To qualify for acceptance, the geotechnical testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E698, that it has the experience and capability to conduct required field and laboratory geotechnical testing without delaying the progress of the work.

### **1.7 PROJECT CONDITIONS**

- A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.
  - 1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
- B. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
  - 1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility company immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility company.
  - 2. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
    - a. Provide minimum of 72 hour notice to Owner, through the Construction Manager, and receive written notice to proceed before interrupting any utility.
- C. Use of Explosives: Use of explosives is not permitted.

- D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
  - 1. Operate warning lights as recommended by authorities having jurisdiction.
  - 2. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
  - 3. Where excavation for utility services requires passing under existing foundations, make this crossing by the smallest possible trench to accommodate the utility service.

## **PART 2 - PRODUCT**

### **2.1 SOIL MATERIALS**

- A. Satisfactory soil materials (soil backfill) are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP.
- B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, OL, OH and PT.
- C. Regular Backfill and Borrow Materials: Satisfactory soil materials.
- D. Subbase Material: Naturally or artificially graded of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2 inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Pipe Cover: Course interlocking aggregate ODOT No. 411 for utilities other than water and fire lines. Pipe cover for water and fire lines is tampered sand. See details on plans.
- F. Bedding Material: Course interlocking aggregate ODOT No. 57, 6, 67, 68, 7, 78 or 8 for utilities other than water and fire lines. Bedding for water and fire lines is tampered sand. See details on plan.
- G. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
- H. Premium Backfill: Course interlocking aggregate ODOT No. 8 or 67.
- I. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2 inch sieve and not more than 8 percent passing a No. 200 sieve.
- J. Filler Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1 inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Sand: ASTM C 33; fine aggregate, natural or manufactured sand.

### **2.2 IDENTIFICATION**

- A. Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mil thick, solid green in color with continuously printed caption in black letters 'CAUTION – UTILITY LINE BURIED BELOW'.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Exercise caution throughout the construction sequence to completely protect persons, property, structures and facilities from damage from exposure, dust, impact, vibration, settlement collapse and other construction-related conditions.
- B. Exercise due care and diligence in cutting, digging under pinning and backfilling operations. Protect overhead and underground utilities that are to remain, including pipe tunnels, sidewalks, drains, curbs, trees, shrubs, adjacent buildings, materials and property from damage. Bear responsibility for, and replacement costs of damage arising from operations connected with this work.
- C. Maintain carefully bench marks, monuments and other reference points; if disturbed or destroyed, replace as directed.



- D. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- E. Provide 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.

### **3.2 STABILITY OF EXCAVATIONS**

- A. Comply with local codes, ordinances, and requirements of agencies having jurisdiction.
- B. Slope sides of excavations. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

### **3.3 DEWATERING**

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

### **3.4 STORAGE OF EXCAVATED MATERIALS**

- A. Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage.
  - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
  - 2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill.

### **3.5 EXCAVATION FOR STRUCTURES**

- A. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.
  - 1. Keep bearing soil dry and free from frost. Remove and replace bearing soil which is softened by water or frost.
- B. Excavation for Underground Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

### **3.6 EXCAVATION FOR WALKS AND PAVEMENT**

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

### **3.7 TRENCH EXCAVATION FOR PIPES, CONDUIT AND DUCTS:**

- A. Exercise extreme caution when excavating and backfilling. Notify the Ohio Public Utilities Protection Service at least 48 hours prior to any excavating to ensure public utilities will not be damaged by the Work.

- B. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 9 inches of clearance on both sides of pipe or conduit.
- C. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations.
  1. Carry excavation 6 inches below required and backfill prior to installation of pipe, conduit or ducts.
  2. For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for bottom  $\frac{1}{4}$  of the circumference.
  3. At each pipe joint, dig bell holes to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

### **3.8 APPROVAL OF SUBGRADE**

- A. Notify Owner when excavations have reached required subgrade.
- B. When Owner determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
  1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner.

### **3.9 UNAUTHORIZED EXCAVATION**

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position when acceptable to the Owner.
  1. Fill unauthorized excavations under other construction as directed by the Owner.
- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Owner.

### **3.10 STORAGE OF SOIL MATERIALS**

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind blown dust.
  1. Stockpile soil materials away from edge of excavations.

### **3.11 COLD WEATHER PROTECTION**

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F.

### **3.12 BACKFILL AND FILL**

- A. Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.
  1. Under grassed areas, use satisfactory or borrow material (earth backfill).
  2. Under pavement use subbase material.
  3. Under steps, use subbase material.
- B. Backfill for Utilities:
  1. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
  2. Place and compact piping course to a height of 12 inches over the utility pipe or conduit, unless otherwise indicated.

- a. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- 3. Coordinate backfilling with utilities testing.
- 4. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- 5. Place and compact regular backfill material to final subgrade for utilities under nonpavement areas.
- 6. Place and compact premium backfill material to final subgrade for utilities under pavement areas.
- 7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.
  - a. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Architect. Use care in backfilling to avoid damage or displacement of pipe systems.
- 8. For interior utility lines within the foundation walls, continue the material around and on top of the utility, placed in six inch layers, and thoroughly compacted until the cover meets or coincides with the free draining aggregate placed beneath interior slabs on grade.
- 9. Exercise care so as not to damage or disturb the utility. Perform backfilling simultaneously on both sides of the utility line to eliminate the possibility of lateral displacement. Water puddling of backfill will not be permitted.
- C. Backfill excavations as promptly as work permits, but not until completion of the following as applicable to the area requiring the backfill:
  - 1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
  - 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
  - 3. Removal of concrete formwork.
  - 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
  - 5. Removal of trash and debris from excavation.
  - 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

### **3.13 PLACEMENT AND COMPACTION**

- A. Place and compact backfill so as to minimize settlement and avoid damage to walls, waterproofing, utility lines and other work in place.
  - 1. Place backfill simultaneously on both sides of freestanding structures. Take proper provisions to prevent wedging action against structure.
  - 2. Place backfill against foundation walls enclosing interior spaces, only after sufficient construction is in place to brace the top of the wall.
- B. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil material, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.
  - 1. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.
- C. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

- D. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- E. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- F. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Architect if soil density tests indicate inadequate compaction.
  - 1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D698:
    - a. Under structures, building slabs and steps, and pavements, compact top 12 inches of subgrade and each layer of backfill or fill material at 98 percent maximum dry density.
    - b. Under lawn or unpaved areas, compact the top 6 inches below subgrade and each layer or backfill or fill material at 95 percent maximum dry density.
  - 2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
    - a. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
    - b. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.
  - 3. If on-site soils are used for fill, close moisture content control will be required to achieve the required degree of compaction. Discing and aerating of the soils during a warm, dry period may be necessary to lower the moisture content. If fill placement must proceed during a wet or cool time of the year, it may be necessary to use imported fill material such as ODOT No. 304 or 411 crush aggregate.

### **3.14 GRADING**

- A. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.
- B. Do all cutting, filling, compacting of fills and rough grading required to bring the entire project area, outside of building, to subgrades as follows:
  - 1. For surfaced areas, (roadways, parking areas, service courts, steps, and walks) to the underside of the respective surfacing or base course, as fixed by the finished grades thereof.
  - 2. For balance of area, to 4" below finished grade, ready for topsoil.
- C. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
  - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than one inch above or below required subgrade elevations.
  - 2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
- D. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½ inch when tested with a 10 foot straight edge.

- E. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

### **3.15 FIELD QUALITY CONTROL**

- A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
  - 1. Perform field density tests in accordance with ASTM D1556 (sand cone method) or ASTM D2167 (rubber balloon method), as applicable.
    - a. Field density tests may also be performed by the nuclear method in accordance with ASTM D2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D3017.
    - b. If field tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.

### **3.16 EROSION CONTROL**

- A. Provide erosion control methods in accordance with the latest edition of the "Ohio Rainwater and Land Development Handbook".
- B. Be responsible for control measures necessary to prevent damage resulting from flooding, erosion, and sedimentation to on-site and off-site areas, throughout the entire period of the Contract.
- C. Install and maintain in good operating condition, temporary desilting basins, terraces, contour furrows, channel linings, waterways or other measures, as required to prevent damage.
- D. Provide temporary measures, or complete the final grading and place topsoil, seed or sod as specified without delay on areas that may be potential contributors to damage because of flooding, erosion and sedimentation. Where areas are sodded early in the life of the project, provide required maintenance and repair until final acceptance.

### **3.17 MAINTENANCE**

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Install erosion protection measures including temporary seeding, construction entrance, and inlet protection as noted on plans and in accordance with the latest edition of the "Ohio Rainwater and Land Development".
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
- D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### **3.18 WARNING TAPE**

- A. Install continuous underground detectable warning tape during backfilling of trench for underground utilities. Locate below finished grade, directly over piping.

### **3.19 DISPOSAL OF EXCESS AND WASTE MATERIALS**

- 1. Remove excess excavated material, trash, debris, and waste materials and dispose of it off Owner's property.

**END OF SECTION 312000**

**SECTION 321216  
HOT-MIX ASPHALT PAVING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Hot-mix asphalt paving.
  - 2. Pavement-marking paint.
- B. Related Sections include the following:
  - 1. Division 31 Section "Earthwork for Utilities" for aggregate subbase and base courses and aggregate pavement shoulders.
  - 2. Division 32 Section "Pavement Joint Sealants" for joint sealants and fillers at paving terminations.
- C. SYSTEM DESCRIPTION
  - 1. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the standard specifications of the State of Ohio Department of Transportation, Construction and Materials specifications last edition.
  - 2. Standard Specification: As indicated.
  - 3. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

**1.3 SUBMITTALS**

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
- C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
- C. Testing Agency Qualifications: Demonstrate to Architect's satisfaction, based on Architect's evaluation of criteria conforming to ASTM D 3666, that the independent testing agency has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- D. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.
- E. Asphalt-Paving Publication: Comply with AI's "The Asphalt Handbook", except where more stringent requirements are indicated.
- F. Preinstallation Conference: Conduct conference at Project site to review methods and procedures related to asphalt paving including, but not limited to, the following:
  - 1. Review condition of substrate and preparatory work performed by other trades.
  - 2. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

3. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
4. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-making materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

### **1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
  1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
  2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

## **PART 2 - PRODUCTS**

### **2.1 AGGREGATES**

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Course Aggregate: Sound; angular crushed stone; or crushed gravel complying with ASTM D 692/D 692M.
- C. Fine Aggregate: Sharp-edged natural sand or sand prepared from stone or gravel, complying with ASTM D1073.
  1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: Rock, hydraulic cement, or other inert material complying with ASTM D 242.

### **2.2 ASPHALT MATERIALS**

- A. Asphalt Cement: ASTM D 3381 for viscosity-graded material.
- B. Prime Coat: ASTM D 977 Asphalt emulsion prime conforming to state Department of Transportation requirements.
- C. Tack Coat: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- D. Water: Potable.
- E. Asphalt Binder: AASHTO M 320

### **2.3 AUXILIARY MATERIALS**

- A. Pavement-Marking Paint: Latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952.
- B. Color: As selected by owner.
- C. Sand: ASTM D 1073, Grade No. 2
- D. Joint Sealant: ASTM D 6690. Hot-applied, single-component, polymer-modified bituminous sealant.

## 2.4 MIXES

- A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI's "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements.
- B. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  - 1. Base Course: ODOT 301.
  - 2. Surface Course: ODOT 441.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll prepared subbase surface below pavements with heavy pneumatic-tired equipment 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.
  - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 20 tons.
  - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earthwork for Utilities".
- C. Notify Owner in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.
- E. Apply pavement surface sealant on joints between asphalt and curbing.
- F. Apply pavement surface sealant on joints between existing and new pavement surfaces.

### 3.2 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
  - 1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Prime Coat: Apply uniformly over surface of compacted-aggregate base at a rate of 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure for 24 hours minimum.
  - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use just enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  - 2. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: If top course of pavement is not installed within same day as base course, apply tack coat uniformly to surfaces of base pavement at a rate of 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.3 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.



1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  2. Spread mix at minimum temperature of 250 deg F.
  3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
  4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide, except where infill edge strips of a lesser width are required.
1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete asphalt base course for a section before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.4 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat.
  2. Offset longitudinal joints in successive courses a minimum of 6 inches.
  3. Offset transverse joints in successive courses a minimum of 24 inches.
  4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook".
  5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  6. Compact asphalt at joints to a density within 2 percent of specified course density.
  7. Apply pavement surface sealant on joints between pavement and curbs.
  8. Apply pavement surface sealant on joints between existing and new pavements.

### 3.5 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and re-rolling to required elevations.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 92-96% of the maximum theoretical density (Rice).
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.
- I. All compaction work shall comply with current state DOT compaction specifications.

### **3.6 INSTALLATION TOLERANCES**

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/4 inch.
  - 2. Surface Course: Plus 1/4 inch, no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Surface Course: 1/8 inch.

### **3.7 PAVEMENT MARKING**

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
- B. Sweep and clean surface to eliminate loose material and dust.
- C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils

### **3.8 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
  - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
  - 1. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, but in no case will fewer than 3 cores be taken.
  - 2. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

**END OF SECTION 321216**

**SECTION 321313  
CONCRETE PAVEMENT**

**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 exterior cement concrete pavement for the following:
  - 1. Driveways aprons.
  - 2. Curbs.
  - 3. Walkways.
  - 4. Wheel stops.
- B. Related Sections include the following:
  - 1. Section 312000 "Earthwork for Utilities" for subgrade preparation, grading, and subbase course.
  - 2. Section 321360 "Pavement Joint Sealants" for joint sealants of joints in concrete pavement and at isolation joints of concrete pavement with adjacent construction.

**1.3 DEFINITIONS**

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

**1.4 SUBMITTALS**

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Qualification Data: For manufacturer and testing agency.
- D. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:
  - 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.
- E. Field quality-control test reports.
- F. Minutes of preinstallation conference.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who 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."
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
  - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

- C. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
  - 1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete producer.
    - d. Concrete pavement subcontractor.
    - e. Manufacturer's representative of stamped concrete paving system used for detectable warnings.

## 1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

## 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. Products: Subject to compliance with requirements, provide one of the products specified.

### 2.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves with a radius 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 will not impair subsequent treatments of concrete surfaces.

### 2.3 STEEL REINFORCEMENT

- A. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 (Grade 420) deformed bars.
- C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, plain steel bars.

### 2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source throughout the Project:
  - 1. Portland Cement: ASTM C 150, Type I
    - a. Fly Ash: ASTM C 618, Class C.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
    - c. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag cement.

- B. Normal-Weight Aggregates: ASTM C 33, coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M.
- D. Air-Entraining Admixture: ASTM C 260.
- E. Chemical Admixtures: Provide 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. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- 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.
- E. Clear Waterborne Membrane – Forming Curing Compound: ASTM C 309, Type 1, Class B.

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with 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, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
  - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.7 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type I or AASHTO M 248, Type N.
  - 1. Color: As selected by Owner.

## 2.8 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
  - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

## 2.9 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28 Days): 4000 psi
  2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
  3. Slump Limit: 4 inches plus or minus 1 inch.
- 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: 5-1/2 percent plus or minus 1.5 percent for 1-1/2-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 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. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements.
  1. Fly Ash or Pozzolan: 25 percent.
  2. Ground Granulated Blast-Furnace Slag: 50 percent.

## **2.10 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
  1. When air temperature is between 85 deg F 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 mixes 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 mixes 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 pavements with heavy pneumatic-tired equipment 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 .
  2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
  3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Division 31 Section "Earthwork for Utilities."
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### **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 for pavement 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**

- 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. 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.
- D. 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.

### **3.5 JOINTS**

- A. General: Form construction, isolation, and contraction joints and tool edgings 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 pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
  - 1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  - 2. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, 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. Protect top edge of joint filler during concrete placement 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 pavement:
  - 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 groover marks on concrete surfaces.
  - 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.

- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
- F. Apply pavement surface sealant on joints between asphalt and curbing.
- G. Apply pavement surface sealant on joints between existing and new pavement surfaces.

### **3.6 CONCRETE PLACEMENT**

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and 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. Do not add water to concrete during delivery or at Project site.
- F. Do not add water to fresh concrete after testing.
- G. 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.
- H. 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.
- I. Place concrete in two operations; strike off initial pour for entire width of placement and to the required depth below finish surface. Lay welded wire fabric or fabricated bar mats immediately in final position. Place top layer of concrete, strike off, and screed.
  - 1. Remove and replace concrete that has been placed for more than 15 minutes without being covered by top layer, or use bonding agent if approved by Architect.
- J. Screed pavement surfaces with a straightedge and strike off.
- K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- L. Curbs: When automatic machine placement is used for curb placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- M. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 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 mix designs.
- N. Hot-Weather 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 to 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.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### **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 bleed-water 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. 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.
  2. 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. Moist 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 for curing concrete, 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 during 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 PAVEMENT TOLERANCES**

- A. Comply with tolerances of ACI 117 and as follows:
  1. Elevation: 1/4 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-foot long, unlevelled straightedge not to exceed 1/4 inch .

4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus 1/4 inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

### **3.10 PAVEMENT MARKING**

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Owner.
- B. Allow concrete pavement to cure for 2 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
- E. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
  1. Before using stamp mats, verify that the vent holes are unobstructed.
  2. Apply liquid release agent to the concrete surface and the stamp mat.
  3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
  4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
  5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

### **3.11 WHEEL STOPS**

- A. Securely attach wheel stops into pavement with not less than two galvanized steel dowels embedded in holes drilled or cast into wheel stops at one-quarter to one-third points. Firmly bond each dowel to wheel stop and to pavement. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

### **3.12 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix 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 mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 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 1 specimen at 7 days and 2 specimens at 28 days.

- a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 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. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

**3.13 REPAIRS AND PROTECTION**

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION 321313**

**SECTION 321360  
PAVEMENT JOINT SEALANTS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes joint sealants for the following:
  - 1. Expansion and contraction joints within portland cement concrete pavement.
  - 2. Joints between portland cement concrete paving and asphalt paving.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 32 Section "Concrete Pavement" for construction of joints in concrete paving.
  - 2. Division 32 Section "Hot-Mixed Asphalt Paving" for construction of joints between asphalt paving and concrete paving.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specifications.
- B. Product data from manufacturers for each joint sealant product required.
- C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples 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.
- D. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.
- C. Preconstruction Compatibility and Adhesion Testing: Submit to joint sealant manufacturer's samples of materials that will contact or affect joint sealants for compatibility and adhesion testing as indicated below:
  - 1. Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
  - 3. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.
- D. Product Testing: Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Architect.
  - 1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C 920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C 719), low-temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

## **1.6 PROJECT CONDITIONS**

- A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
  - 2. When joint substrates are wet.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS, GENERAL**

- A. Compatibility: Provide joint sealants, joint fillers, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 1. Match colors indicated by reference to manufacturer's standard designations.

### **2.2 COLD-APPLIED JOINT SEALANTS**

- A. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
    - b. Dow Corning Corporation; 890-SL
    - c. Pecora Corporation; 300-SL
- B. Silicone Sealant for Concrete and Asphalt: One-part, low-modulus, neutral-cure silicone sealant complying with ASTM C 920, Type S, Grade P, Class 25, and Uses T, M, and as applicable to joints with concrete and asphalt substrates, O and with the following requirements:
  - 1. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage changes in joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920 for Uses indicated:
  - 2. 100 percent movement in extension and 50 percent movement in compression for a total of 150 percent movement.

### **2.3 HOT-APPLIED JOINT SEALANTS**

- A. Elastomeric Sealant for Concrete: One-part formulation complying with ASTM D 3406.
- B. Sealant for Concrete and Asphalt: One-part formulation complying with ASTM D 3405.
- C. Low-Modulus Sealant for Concrete and Asphalt: Proprietary, pourable petropolymer formulation with the following physical properties measured per ASTM D 3407.
- D. Available Products: Subject to compliance with requirements, provide one of the following:
  - 1. Elastomeric Sealant for Concrete:
    - a. "Product #9012," Koch Materials Co.
    - b. "ROADSAVER 221," Crafco Inc.

2. Sealant for Concrete and Asphalt:
  - a. "ROADSAVER 221," Crafco Inc.
  - b. "Product #9005," Koch Materials Co.
  - c. "Product #9030," Koch Materials Co.
  - d. "SEALTIGHT HI-SPEC," W.R. Meadows, Inc.
3. Low-Modulus Sealant for Concrete and Asphalt:
  - a. "SEALTIGHT SOF-SEAL," W.R. Meadows, Inc.

## 2.4 JOINT FILLERS FOR CONCRETE PAVING

- A. General: Provide joint fillers of thicknesses and widths indicated.
- B. Bituminous Fiber Joint Filter: Preformed strips of composition below, complying with ASTM D 1751:
  1. Asphalt saturated fiberboard.
  2. Granulated cork with asphalt binder encased between 2 layers of saturated felt or glass-fiber felt of width and thickness indicated.

## 2.5 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Backer Rods for Cold-Applied Sealants: Preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding strips of flexible, plastic foam of material indicated below and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  1. Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state.
  2. Proprietary, reticulated, closed-cell polymeric foam, non-outgassing, with a density of 2.5 pcf and tensile strength of 35 psi per ASTM D 1623, and with water absorption less than 0.02 gram/cubic centimeter per ASTM C 1083.
  3. Either material indicated above.
- C. Backer Rods for Hot-Applied Sealants: Crosslinked, closed-cell polyolefin foam or polyethylene foam, non-outgassing, nonstaining, and capable of withstanding high temperatures of hot-applied joint sealants.
  1. Available Products: Subject to compliance with requirements, provide one of the following:
    - a. "HBR XL," Applied Extrusion Technologies., Inc.
    - b. "SEALTIGHT CERA-ROD," W.R. Meadows, Inc.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.6 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer.
- B. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

### **3.3 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with joint sealant manufacturer's printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
  - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
    - a. Do not leave gaps between ends of joint fillers.
    - b. Do not stretch, twist, puncture, or tear joint fillers.
    - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- F. Provide joint configuration to comply with recommendations of sealant manufacturer unless otherwise indicated.
- G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.
- H. Apply pavement surface sealant on joints between asphalt pavement and curbing.
- I. Apply pavement surface sealant on joints between existing and new pavement surfaces.

### **3.4 CLEANING**

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved 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 or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that installations with repaired areas are indistinguishable from original work.

END OF SECTION 321360



**SECTION 323113  
CHAIN LINK FENCES AND GATES**

**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. Chain-link fences.
  - 2. Gates: swing.
- B. Related Sections:

**1.3 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design chain-link fences and gates, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
  - 1. Minimum Post Size: Determine according to ASTM F 1043 for framework up to 12 feet high, and post spacing not to exceed 10 feet.
- C. Lightning Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

**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 chain-link fences and gates.
  - 1. Fence and gate posts, rails, and fittings.
  - 2. Chain-link fabric, reinforcements, and attachments.
  - 3. Gates and hardware.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.
  - 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Delegated-Design Submittal: For chain-link fences and gate framework indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Product Certificates: For each type of chain-link fence, operator, and gate, from manufacturer.
- F. Product Test Reports: For framing strength according to ASTM F 1043.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:
  - 1. Polymer finishes.
  - 2. Gate hardware.
  - 3. Gate operator.
- I. Warranty: Sample of special warranty.

## 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding. Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:
  - 1. Steel Wire Fabric: Wire with a diameter of 0.148 inch.
    - a. Mesh Size: 2 inches.
    - b. Aluminum-Coated Fabric: ASTM A 491, Type I, 0.40 oz./sq. ft.
    - c. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.
    - d. Zn-5-Al-MM Aluminum-Mischmetal-Coated Fabric: ASTM F 1345, Type III, Class 1, 0.60 oz./sq. ft. Retain first subparagraph below for polymer coating over metallic-coated steel wire fabric.
    - e. Polymer-Coated Fabric: ASTM F 668, [Class 1] [Class 2a] [Class 2b] over [aluminum] [zinc] [Zn-5-Al-MM-alloy]-coated steel wire.
      - 1) Color: [Dark green] [Olive green] [Brown] [Black] [As selected by Architect from manufacturer's full range], complying with ASTM F 934.
    - f. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.
  - 2. Aluminum Wire Fabric: ASTM F 1183, and wire diameter of 0.148 inch.
    - a. Mesh Size: 2 inches.

### 2.2 FENCE FRAMING

- A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:
  - 1. Fence Height: 72 inches.
  - 2. Light Industrial Strength: Material Group IC-L, round steel pipe, electric-resistance-welded pipe.
    - a. Line Post: 2.375 inches in diameter 2.875 inches.
    - b. End, Corner and Pull Post: 2.875 inches.
  - 3. Heavy Industrial Strength: Material Group IA, round steel pipe, Schedule 40.
    - a. Line Post: 2.875 inches in diameter.
    - b. End, Corner and Pull Post: 2.875 inches in diameter.
  - 4. Horizontal Framework Members: Intermediate, top and bottom rails complying with ASTM F 1043.
  - 5. Brace Rails: Comply with ASTM F 1043.
  - 6. Metallic Coating for Steel Framing:
    - a. Type A, consisting of not less than minimum 2.0-oz./sq. ft. average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. zinc coating per ASTM A 653/A 653M.
    - b. Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.

- c. External, Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil- thick, zinc-pigmented coating.
- d. Type C, Zn-5-Al-MM alloy, consisting of not less than 1.8-oz./sq. ft. coating.
- e. Coatings: Any coating above.

### 2.3 TENSION WIRE

- A. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:
  - 1. Type I, aluminum coated (aluminized).
  - 2. Type II, zinc coated (galvanized) by hot-dip process, with the following minimum coating weight:
    - a. Class 4: Not less than 1.2 oz./sq. ft. of uncoated wire surface.
  - 3. Type III, Zn-5-Al-MM alloy with the following minimum coating weight:
    - a. Class 60: Not less than 0.6 oz./sq. ft. of uncoated wire surface.
- B. Aluminum Wire: 0.192-inch- diameter tension wire, mill finished, complying with ASTM B 211, Alloy 6061-T94 with 50,000-psi minimum tensile strength.

### 2.4 SWING GATES

- A. General: Comply with ASTM F 900 for gate posts and [single] [double] swing gate types.[ Provide automated vehicular gates that comply with ASTM F 2200.]
  - 1. Gate Leaf Width: 36 inches.
  - 2. Gate Fabric Height: 72 inches.
- B. Pipe and Tubing:
  - 1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.
  - 2. Aluminum: Comply with ASTM B 429/B 429M.
  - 3. Gate Posts: Round tubular steel .
  - 4. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings].
- D. Hardware:
  - 1. Hinges: 180-degree inward, 180-degree outward, 360-degree inward and outward swing.
  - 2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

### 2.5 FITTINGS

- A. General: Comply with ASTM F 626.
- B. Post Caps: Provide for each post.
  - 1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
  - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.
- E. Tension and Brace Bands: Pressed steel or Aluminum Alloy 6063.
- F. Tension Bars: Steel or Aluminum, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
  - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
    - a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire[; galvanized coating thickness matching coating thickness of chain-link fence fabric].

- b. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; 0.192-inch- diameter, mill-finished wire.
- H. Finish:
  - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.
    - a. Polymer coating over metallic coating.
  - 2. Aluminum: Mill finish.

**2.6 GROUT AND ANCHORING CEMENT**

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

**2.7 FENCE GROUNDING**

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
  - 1. Material above Finished Grade: [Copper] [Aluminum].
  - 2. Material on or below Finished Grade: Copper.
  - 3. Bonding Jumpers: Braided copper tape, 1 inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Comply with UL 467.
  - 1. Connectors for Below-Grade Use: Exothermic welded type.
  - 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 200 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

**3.3 INSTALLATION, GENERAL**

- A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.
  - 1. Install fencing on established boundary lines inside property line.

**3.4 CHAIN-LINK FENCE INSTALLATION**

- A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
  - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
  - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
  - b. Concealed Concrete: Top 2 inches below grade to allow covering with surface material.
  - c. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
  - d. Posts Set into Voids in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment.
- D. Line Posts: Space line posts uniformly at 10 feet o.c.
- E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
  1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
  1. Extended along top and bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
- G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Intermediate and Bottom Rails: Install and secure to posts with fittings.
- I. Chain-Link Fabric: Apply fabric to inside of enclosing framework. Leave **1 inch** between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than **15 inches** o.c.
- K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  1. Maximum Spacing: Tie fabric to line posts at **12 inches** o.c. and to braces at **24 inches** o.c.
- L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

**3.5 GATE INSTALLATION**

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

**3.6 ADJUSTING**

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

**END OF SECTION 323113**

**SECTION 329200  
LAWNS AND GRASSES**

**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. Seeding.
  - 2. Hydroseeding.
  - 3. Erosion-control material(s).
- B. Related Sections:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 312000 "Earthwork for Utilities " for excavation, filling and backfilling, and rough grading.

**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. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- G. 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 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for turfgrass and sod. Include identification of source and name and telephone number of supplier.
- B. Qualification Data: For qualified landscape Installer.
- C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

## **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
  - 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: Three years' experience in turf installation.
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

## **1.7 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: 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.

## **1.8 PROJECT CONDITIONS**

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
  - 1. Spring Planting: March 15 to June 10
  - 2. Fall Planting: August 15 to October 1
- B. 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.

## **1.9 MAINTENANCE SERVICE**

- A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape 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. Seeded Turf: 60 days from date of planting completion.
    - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

## **PART 2 - PRODUCTS**

### **2.1 SEED**

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species as follows:
- C. Seed Species: Seed of grass species as follows, with not less than 95 percent germination, not less 85 percent pure seed, and not more than 0.5 percent weed seed:
  - 1. Full Sun: Bermudagrass (*Cynodon dactylon*).
  - 2. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.



3. Sun and Partial Shade: Proportioned by weight as follows:
  - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
  - b. 30 percent chewings red fescue (*Festuca rubra* variety).
  - c. 10 percent perennial ryegrass (*Lolium perenne*).
  - d. 10 percent redtop (*Agrostis alba*).
4. Shade: Proportioned by weight as follows:
  - a. 50 percent chewings red fescue (*Festuca rubra* variety).
  - b. 35 percent rough bluegrass (*Poa trivialis*).
  - c. 15 percent redtop (*Agrostis alba*).

## 2.2 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

## 2.3 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
- C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 4-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Invisible Structures, Inc.; Slopetame 2.
    - b. Presto Products Company, a business of Alcoa; Geoweb.
    - c. Tenax Corporation - USA; Tenweb.

## 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, trees, shrubs, and plantings from damage caused by planting operations.
  1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

2. 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. 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 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    - a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.
    - b. Reduce elevation of planting soil to allow for soil thickness of sod.
- 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. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
  4. 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 PREPARATION FOR EROSION-CONTROL MATERIALS**

- A. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- B. Fill cells of erosion-control mat with planting soil and compact before planting.
- C. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- D. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### **3.5 SEEDING**

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
1. Do not use wet seed or seed that is moldy or otherwise damaged.
  2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 5 to 8 lb/1000 sq. ft.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where shown on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
  - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
  - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

### **3.6 HYDROSEEDING**

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
  - 1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
  - 2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
  - 3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

### **3.7 CLEANUP AND 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 333100**  
**DOMESTIC WATER/PRIVATE FIRE SERVICE MAINS**

**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 water-distribution piping and specialties from the source of potable (domestic) water to a (point 5 feet outside the building) (point inside building as indicated)(as indicated on the plans).
  - 1. Water services.
  - 2. Fire-service mains.
  - 3. Combined water service and fire-service mains.
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 31 Section "Earthwork for Utilities" for excavation and backfill required for service piping and structures.
  - 2. Division 22 Section "Plumbing Piping" for interior building water piping systems and equipment.
  - 3. Division 21 Section "Fire Protection" for interior building fire protection piping systems and equipment.

**1.3 DEFINITIONS**

- A. Combined Water Service and Fire-Service Main: Exterior water piping for both domestic-water and fire-suppression piping.
- B. Fire-Service Main: Exterior fire-suppression-water piping.
- C. Fire-Suppression-Water Piping: Interior fire-suppression-water piping.
- D. Water-Distribution Piping: Interior domestic-water piping.
- E. Water Service: Exterior domestic-water piping.
- F. The following are industry abbreviations for plastic materials:
  - 1. PE: Polyethylene plastic.
  - 2. PP: Polypropylene plastic.
  - 3. PVC: Polyvinyl chloride plastic.

**1.4 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Piping specialties.
  - 2. Valves and accessories.
  - 3. Underground warning tape.
- B. Field Quality-Control Test Reports: From Contractor.
- C. Operation and Maintenance Data: For specialties to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Valves.

## **1.5 QUALITY ASSURANCE**

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of piping and specialties and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- B. Regulatory Requirements:
  - 1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.
  - 2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
  - 3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
- C. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.
- F. Comply with FM's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.
- G. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.
- H. NSF Compliance:
  - 1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

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

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

## **1.7 PROJECT CONDITIONS**

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.

## **1.8 COORDINATION:**

- A. Coordinate connection to water main with utility company.

## **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. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPING MATERIALS**

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

### **2.3 DUCTILE-IRON PIPE AND FITTINGS**

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint, bell- and plain-spigot end unless grooved or flanged ends are indicated.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.

### **2.4 CORROSION-PROTECTION ENCASEMENT FOR PIPING**

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

### **2.5 GATE VALVES**

- A. AWWA, Cast-Iron Gate Valves:
  - 1. Manufacturer[s] subject to compliance with requirements, provide products by one of the following:
    - American Cast Iron Pipe Co.; American Flow Control Div.
    - Crane Co.; Crane Valve Group; Stockham Div.
    - East Jordan Iron Works, Inc.
    - Grinnell Corporation; Mueller Co.; Water Products Div.
    - McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).
    - McWane, Inc.; Kennedy Valve Div.
    - McWane, Inc.; Tyler Pipe; Utilities Div.
    - NIBCO INC.
    - United States Pipe and Foundry Company.
  - 2. Nonrising-Stem, Resilient-Seated Gate Valves: AWWA C509, gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
    - a. Minimum Working Pressure: 200 psig.
    - b. End Connections: Mechanical joint.
    - c. Interior Coating: Complying with AWWA C550.

### **2.6 GATE VALVE ACCESSORIES AND SPECIALTIES**

- A. Tapping-Sleeve Assemblies: Comply with MSS SP-60. Include sleeve and valve compatible with drilling machine.
  - 1. Manufacturers:
    - American Cast Iron Pipe Co.; Waterous Co. Subsidiary.
    - East Jordan Iron Works, Inc.

Grinnell Corporation; Mueller Co.; Water Products Div.  
McWane, Inc.; Clow Valve Co. Div. (Oskaloosa).  
McWane, Inc.; Kennedy Valve Div.  
McWane, Inc.; M & H Valve Company Div.  
United States Pipe and Foundry Company.

2. Tapping Sleeve: Cast- or ductile-iron or stainless steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
  3. Valve: AWWA, cast-iron, nonrising-stem, resilient seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," bottom section with base of size to fit over valve, and approximately 5-inch diameter barrel.
1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

## **2.7 IDENTIFICATION**

- A. Plastic Underground Warning Tapes: Polyethylene plastic tape, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION – WATER LINE BURIED BELOW".

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Refer to Division 31 Section "Earthwork for Utilities" for excavating, trenching, and backfilling.

### **3.2 PIPING APPLICATIONS**

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Do not use flanges, unions, or keyed couplings for underground piping.
- D. Flanges, unions, keyed couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground Water-Service Piping: Use any of the following piping materials for each size range:
1. NPS 3 to NPS 15: Ductile-iron with push-on-joint pipe, push-on-joint fittings, and gasketed.
- F. Underground Fire-Service-Main Piping: Use the following:
1. NPS 3 to NPS 15: Ductile-iron with push-on-joint pipe, push-on-joint fittings, and gasketed.
- G. Underground Combined Water-Service and Fire-Service-Main Piping: Use the following:
1. NPS 3 to NPS 15: Ductile-iron with push-on-joint pipe, push-on-joint fittings, and gasketed.

### **3.3 VALVE APPLICATIONS**

- A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FM, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient seated gate valves with valve box.

### **3.4 JOINT CONSTRUCTION**

- A. Make pipe joints according to the following:
  1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

### **3.5 PIPING INSTALLATION**

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
  1. Install tapping sleeve and tapping valve according to MSS SP-60.
  2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- C. Comply with NFPA 24 for fire-service-main piping materials and installation.
  1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- E. Bury piping with depth of cover over top at least 54 inches, with top at least 12 inches below level of maximum frost penetration.
- F. Extend water-service piping and connect to water-supply source and building water piping systems at outside face of building wall in locations and pipe sizes indicated.
  1. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water piping systems when those systems are installed.
- G. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- H. See Division 22 Section "Plumbing Piping" for potable-water piping inside the building.
- I. See Division 21 Sections for fire-suppression water piping inside the building.
- J. Install water-supply piping with shutoff valve in water supply to each post hydrant. Use curb valve and service box.

### **3.6 ANCHORAGE INSTALLATION:**

- A. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:
  1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
  2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
  3. Fire-Service-Main Piping: According to NFPA 24.
- B. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

### **3.7 VALVE INSTALLATION**

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. UL/FM Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

### **3.8 FIELD QUALITY CONTROL**

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.



- B. Hydrostatic Tests: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure without loss for 2 hours.
  - 1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

**3.9 IDENTIFICATION**

- A. Install acid-and alkali-resistant polyethylene 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 the 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.
- B. Permanently attach equipment nameplate or marker, indicating plastic water-service piping, on main electrical meter panel.

**3.10 CLEANING**

- A. Clean and disinfect water-distribution piping as follows:
  - 1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.
  - 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
  - 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or as described below:
- B. At the time of construction place calcium hypochlorite granules in the pipeline at the upstream end of the first section of pipe, at each branch main and at 500 foot intervals in accordance with Table 1 of AWWA C601.

TABLE 1

Ounces of Calcium Hypochlorite Granules  
To be Place at Beginning of Main  
And at Each 500-ft interval

Pipe Diameter In.	Calcium Hypochlorite Granules Oz.
4	0.5
6	1.0
8	2.0
12	4.0
16 and larger	8.0

- C. After the water line or portion thereof is complete and pressure tested, carefully and thoroughly flush the lines with potable water.

- D. Upon completion of the flushing operation, sterilize the lines using chlorine solution feed machine or other approved equipment to place a hypochlorite solution into the water line and service lines as far as the curb stops. Introduce sufficient chlorine into the lines to produce a chlorine residual of not less than 25 mg/1. Retain this residual in the lines for not less than 24 hours. At the end of the holding period remove the chlorinated water, thoroughly flush the lines and fill with potable water from the distribution system.
- E. Collect and test water samples from the newly sterilized lines in accordance with the latest edition of standard methods of Examination of Water and Wastewater, for three days for any evidence of contamination.
- F. In the event that the tests show the need for rechlorination, repeat the sterilization procedure as often as may be necessary until satisfactory results are obtained. No additional charge will be approved for rechlorination requirements.
- G. Prepare reports of purging and disinfecting activities.

**END OF SECTION 333100**

**SECTION 333200  
NATURAL GAS SERVICE PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes natural gas service piping, specialties, and accessories outside the building from the connection to the utility company gas main to the discharge of the gas meter.
- B. Arranging for, making and paying for the final connection to the utility company gas main is work of this section.
- C. Related Sections: The following Section contains requirements that relate to this Section.
  - 1. Division 22 Section "Natural Gas Piping Systems" for natural gas piping inside building.
  - 2. Division 31 "Earthwork for Utilities" for trenching and backfilling materials and methods for natural gas service piping included as work of this section.

**1.3 DEFINITIONS**

- A. Pipes sizes used in this Section are nominal pipe size (NPS) specified in inches.
- B. Gas Main or Distribution Main: Piping to convey gas from gas source to individual gas services or other gas mains.
- C. Gas Service: Pipe from gas main or other source to building being served. Piping includes gas service piping, gas valve, service pressure regulator, meter bar or meter support, and gas meter.
- D. Gas Piping System: Pipe inside building that conveys gas from gas service to points of use.

**1.4 SYSTEM PERFORMANCE REQUIREMENTS:**

- A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for natural gas service piping.
  - 1. Gas Main: 150 psig.
  - 2. Gas Service: 150 psig.

**1.5 SUBMITTALS**

- A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Record drawings at Project closeout of installed natural gas system piping and products according to Division 01 Section "Project Closeout".
- C. Test reports specified in "Field Quality Control" Article in Part 3.

**1.6 QUALITY ASSURANCE**

- A. Comply with requirements of utility supplying natural gas. Include tapping of gas mains.
- B. Comply with standards of authorities having jurisdiction for natural gas piping systems. Include materials, installation, and testing.
- C. Comply with the "NFPA 54 and Gas Company Regulations", for gas piping materials and components; installations; and inspection, testing, and purging.
- D. Comply with the BOCA National Mechanical Code, Chapter 8 "Gas Piping Systems", for gas piping materials and components; installations; and inspection, testing, and purging.
- E. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.
- F. Listing and Labeling: Provide equipment and accessories that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code", Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

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

- A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle liquids cautiously to avoid spillage and ignition. Notify gas supplier. Handle flammable liquids used by Installer with proper precautions. Do not leave on the premises overnight.
- B. Preparation for Transport: Prepare valves for shipping as follows:
  1. Ensure that valves are dry and internally protected against rust and corrosion.
  2. Protect valves against damage to threaded ends, flange faces, and weld ends.
  3. Set valves in the best position for handling. Set valves closed to prevent rattling.
- C. Storage: Use the following precautions for valves during storage:
  1. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.
  2. Protect valves from weather. Store valves indoors and maintain a temperature higher than ambient dew point temperature. Support valves off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- D. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.
- E. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent damage and entrance of dirt, debris, and moisture.
- F. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when stored inside.
- G. Protect flanges, fittings and piping specialties from moisture and dirt.
- H. Store plastic pipes and valves protected from direct sunlight. Support pipes to prevent sagging and bending.

### **1.8 PROJECT CONDITIONS**

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility locating service for area where Project is located.
- B. Verify that natural gas distribution systems piping may be installed in compliance with original design and referenced standards.

### **1.9 SEQUENCING AND SCHEDULING**

- A. Coordinate connection to gas main with utility company.
- B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of building natural gas piping systems.
- C. Coordinate with other utility work.
- D. Notification of Interruption of Service: Notify each affected user when gas supply will be turned off.
- E. Work Interruptions: Leave natural gas main and service piping in a safe condition when interruptions in work occur while alterations or repairs are being made to existing gas piping systems.

## **PART 2 - SYSTEMS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Gas Valves, plastic:

## **2.2 PIPES**

- A. Refer to Part 3 "Piping Applications" Article for pipe materials required for each system.
- B. Plastic Pipe: ASTM D 2513, polyethylene (PE), DR 11 or DR 11.5.

## **2.3 PIPE FITTINGS**

- A. Refer to Part 3 "Piping Applications" Article for pipe-fitting materials required for each system.
- B. Plastic Pipe Fittings: ASTM D 2513, polyethylene, butt-fusion type; and ASTM D 2683, polyethylene, socket-fusion type.
- C. Transition Fittings: Type, material, and end connections to match piping being joined.

## **2.4 JOINING MATERIALS**

- A. Refer to Part 3 "Piping Applications" Article for joining materials required for each system.
- B. Welding-Joint Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe.
- C. Threaded-Joint Compound and Tape: Suitable for natural gas.
- D. Plastic-Pipe, Fusion-Joint Procedure: According to plastic pipe and valve manufacturers' written instructions.
- E. Plastic-Pipe, Flanged-Joint Gasket Material, Bolts, and Nuts: Type and material recommended by piping system manufacturer for natural gas service, except where other type or material is indicated.

## **2.5 GAS VALVES**

- A. Manual Valves: Conform to standards listed, or where appropriate, valves according to ANSI Z21.15 and ANSI Z21.15a.
- B. Plastic Gas Valves: ASME B16.40, polyethylene (PE), SDR 11.
- C. Valve Boxes: Cast-iron, 2-section box. Top section includes cover with lettering "GAS." Bottom section includes base of size to fit over valve and barrel approximately 5 inches in diameter. Valve box includes adjustable cast-iron extension of length required for depth of bury of valve.
  - 1. Furnish 1 steel operating wrench with each valve box. Include tee-handle with 1 pointed end, stem of length required to operate valve, and socket fitting valve operating nut.

## **2.6 PIPING SPECIALTIES**

- A. Service Line Risers: Polyethylene (PE) plastic pipe with coated (annodeless) steel pipe casing on riser section. Include inlet for heat-fusion connection to PE service pipe and outlet for connection to gas valve.

## **2.7 BASIC IDENTIFICATION**

- A. . Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION – GAS MAIN BURIED BELOW".

## **PART 3 - EXECUTION**

### **3.1 EARTHWORK**

- A. Perform excavation, trenching, and backfilling in accordance with Division 31 Section "Earthwork for Utilities".
- B. Comply with NFPA 54 "Prevention of Accidental Ignition".

### **3.2 PIPING APPLICATIONS**

- A. Flanges, unions, transition and special fittings, and valves with pressure ratings the same or higher than system's pressure rating may be used in the following aboveground applications except where specified otherwise.
- B. Aboveground Gas Service Piping to Gas Meter: Use plastic pipe, plastic pipe fittings, and fusion joints. Joints for connection to threaded regulators, meters, and valves may be made with threaded transition fittings.
- C. Underground Gas Distribution and Service Piping: Use plastic pipe, plastic pipe fittings, and fusion joints.

### **3.3 VALVE APPLICATIONS**

- A. Use gas valves of sizes indicated for gas service piping, meters, mains, and where indicated.
- B. Use plastic gas valves on plastic gas distribution piping. Install on buried piping with valve box.
- C. Use valve and fitting assemblies made for tapping gas mains for connections to existing gas mains.

### **3.4 JOINT CONSTRUCTION**

- A. Use materials suitable for natural gas service.
- B. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to pipe manufacturer's printed instructions.
  1. Plain-End Pipe and Fittings: Butt joining.
  2. Plain-End Pipe and Socket-Type Fittings: Socket joining.

### **3.5 PIPING INSTALLATIONS**

- A. Install buried gas distribution system piping with a 30 inch minimum cover. Include underground warning tape.
- B. Install underground, plastic, gas distribution piping according to ASTM D 2774.
- C. Install continuous underground detectable warning tape during backfilling of trench for underground water-service piping. Locate below finished grade, directly over piping. See Division 31 Section "Earthwork for Utilities" for underground warning tapes.

### **3.6 VALVE INSTALLATION**

- A. Install valves where indicated and on each branch connection to existing gas main. Install buried valves with valve boxes.
- B. Install valves in accessible locations, protected from physical damage. Tag valves with metal tag attached with metal chain indicating piping systems supplied.
- C. Install specialty valves according to manufacturer's written instructions.

### **3.7 CONNECTIONS**

- A. Extend and connect natural gas service piping to gas source and to the building. The building's natural gas systems are specified in Division 23 Section "Natural Gas Piping Systems".
  1. Terminate gas service system piping at building wall until building's natural gas piping systems are installed. Terminate piping with caps, plugs, or flanges, as required for piping material. Make connections to building's gas systems when those systems are installed.
- B. Connect to utility company gas main according to utility company's procedures and requirements.
- C. Connect to existing gas main according to ASME B31.8.

### **3.8 ELECTRICAL BONDING AND GROUNDING**

- A. Install aboveground portions of natural gas piping systems that are upstream from equipment shutoff valves, electrically continuous, and bonded to ground electrode according to NFPA 70.
- B. Do not use gas piping as a grounding electrode.

### **3.9 LABELING AND IDENTIFYING**

- A. General: Install labeling and identification in accordance with Division 22 Section "Identification for Plumbing Piping and Equipment".

**3.10 FIELD QUALITY CONTROL**

- A. Inspect, test, and purge natural gas systems according to NFPA 54, Part 4, "Gas Piping Inspection, Testing, and Purging" and local gas utility company requirements.
- B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
- C. Report test results promptly in writing to the Architect and the authorities having jurisdiction.
- D. Verify that specified piping tests are complete.

**3.11 ADJUSTING**

- A. Adjust controls and safety devices. Replace damaged and malfunctioning controls and safety devices.

**END OF SECTION 333200**

**SECTION 334100  
STORM SEWERAGE**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and supplementary conditions and other Division 01 specification sections, apply to this section.

**1.2 SUMMARY:**

- A. This section includes storm sewerage system piping and appurtenances from a point 5 feet outside of the building to the point of disposal or discharge into the public sewer system.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 31 Section "Earthwork for Utilities" for excavation and backfill required for storm sewerage system piping and structures.
  - 2. Division 22 Section "Plumbing Piping" for building storm drains.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 specification Sections.
- B. Product data for drainage piping specialties.
- C. Shop drawings for precast concrete storm drainage manholes and catch basins, including frames, covers, and grates.

**1.4 QUALITY ASSURANCE**

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to storm sewerage systems.

**1.5 PROJECT CONDITIONS**

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.
  - 1. Locate existing storm sewerage system piping and structures that are to be abandoned and closed.

**1.6 SEQUENCING AND SCHEDULING**

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building storm drainage piping.
- C. Coordinate with other utility work.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Frames, Covers and Grates:
    - East Jordan Iron Works, Inc.
    - Neenah Foundry Company
  - 2. Underground Warning Tapes:
    - Allen Systems, Inc.; Reef Industries, Inc.
    - Brady (W.H.) Co.; Signmark Div.
    - Seton Name Plate Co.



## 2.2 PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products are indicated, selection is installer's option.
- B. HDPE (High Density Polyethylene): ASTM D3350 with joints meeting AASHTO M252, Type S, silt tight, smooth interior lining.
  - 1. Gaskets: ASTM F477.
- C. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
  - 1. Gaskets: ASTM F477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

## 2.3 MANHOLES

- A. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, or depth indicated with provision for rubber gasket joints.
  - 1. Base Section: 6 inch minimum thickness for floor slab and 5 inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
  - 2. Riser Sections: 5 inch minimum thickness, 48 inch diameter, and lengths to provide depth indicated.
  - 3. Top Section: Eccentric cone type, unless concentric cone or flat slab top type is indicated. Top of cone to match grade rings.
  - 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 12 inches total thickness and match 24 inch diameter frame and cover.
  - 5. Gaskets: ASTM C 443, rubber.
  - 6. Steps: Cast into base, riser, and top sections sidewall at 12 to 16 inch intervals.
  - 7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
  - 8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
  - 9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
- B. Channel and Bench: Concrete.
- C. Manhole Frames and Covers: Heavy duty, gray iron casting from iron conforming to ASTM A48 Class 35B, 24 inch inside diameter by 7 to 9 inch riser with 4 inch minimum width flange, and 26 inch diameter cover, checkered top design, with lettering "STORM SEWER" cast into cover.

## 2.4 SMALL CATCH BASINS

- A. Precast Concrete Catch Basins: Precast reinforced concrete, of depth indicated. Multi-section catch basins shall have provision for rubber gasket joints. Precast concrete catch basins shall have a minimum wall and floor slab thickness of 4 inches and have minimum interior dimensions of 24 inches by 24 inches or 24 inch diameter.
  - 1. Gaskets: ASTM C 443, rubber.
  - 2. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to catch basin.
  - 3. Frames and Grates: Heavy duty, gray iron casting from iron conforming to ASTM A48 Class 35B, minimum 22 inches by 22 inches inside dimensions or 22 inch inside diameter with minimum 6 inch riser and 4 inch minimum width flange, and 24 inches by 24 inches or 24 inch diameter flat grate with small square or short slotted (bicycle safe) drainage openings.

## 2.5 CLEANOUTS

- A. General: Where indicated on drawings, or where indicated by the local authority having jurisdiction, provide a vertical riser pipe from the storm sewer to the finished grade, the riser shall be the full size of the storm sewer or a minimum of 6 inch size for storm sewers over 6 inches in size. For cleanouts, the riser shall join the storm sewer at a 45 degree angle through

a wye fitting; for test wells, the riser pipe shall join the storm sewer vertically through a tee fitting.

1. Manhole Frames and Covers: Heavy duty, gray iron casting from iron conforming to ASTM A48 Class 35B, 8-1/2 inch minimum inside diameter by 11 inch minimum riser with 4 inch minimum width flange, and minimum 9-1/2 inch diameter cover, checkered top design, cover bolted to frame.

## **2.6 IDENTIFICATION**

- A. Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION – SEWER LINE BURIED BELOW".

## **PART 3 - EXECUTION**

### **3.1 PREPARATION OF FOUNDATION FOR BURIED STORM SEWERAGE SYSTEMS**

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

### **3.2 PIPE APPLICATIONS FOR UNDERGROUND STORM SEWERS**

- A. Pipe Sizes 4 Inches to 60 Inches: HDPE gasket joint sewer pipe and fittings.

### **3.3 INSTALLATION, GENERAL**

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangement of piping layout taken into account in many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets and seals in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use manholes or catch basins for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- F. Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.
- G. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

### **3.4 MANHOLES**

- A. General: Install manholes complete with accessories as indicated. Form continuous concrete channel and benches between inlets and outlets where indicated on drawings. Set tops of frames and covers flush with finish.
- B. Place precast concrete manhole sections as indicated, and install in accordance with ASTM C 891.
- C. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.
- D. Apply bituminous mastic coating at joints of sections.

### **3.5 CLEANOUTS**

- A. Install cleanouts from sewer pipe to grade as indicated. Set frame and cover in concrete pad with minimum dimensions of 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout flush with grade when installed in paving.

### **3.6 CATCH BASINS**

- A. Install catch basins of types as indicated.
- B. Set frames and grates to elevations indicated.

### **3.7 INSTALLATION OF IDENTIFICATION**

- A. Install continuous plastic underground warning tape during backfilling of trench for underground storm piping. Locate 6 to 8 inches below finished grade, directly over piping.

### **3.8 FIELD QUALITY CONTROL**

- A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.
- B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
  - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
  - 3. Flush piping between manholes, if required by local authority, to remove collected debris.
- C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
  - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
  - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and reinspect.

**END OF SECTION 334100**

**SECTION 335100  
SANITARY SEWERAGE**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal or discharge into the public sewer system.
- B. Related Sections: The following sections contain requirements that relate to this section:
  - 1. Division 31 Section "Earthwork for Utilities" for excavation and backfill required for sanitary sewerage system piping and structures.
  - 2. Division 22 Section "Plumbing Piping" for building sanitary drains.

**1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

**1.4 QUALITY ASSURANCE**

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.

**1.5 PROJECT CONDITIONS**

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that sanitary sewerage system piping may be installed in compliance with original design and referenced standards.
  - 1. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.

**1.6 SEQUENCING AND SCHEDULING**

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Manhole Frames and Covers:
    - East Jordan Iron Works, Inc.
    - Neenah Foundry Company
  - 2. Underground Warning Tapes:
    - Allen Systems, Inc.; Reef Industries, Inc.
    - Brady (W.H.) Co.; Signmark Div.
    - Seton Name Plate Co.

## **2.2 PIPE AND FITTINGS**

- A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products are indicated, selection is Installer's option.
- B. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for solvent cement or elastomeric gasket joints.
  - 1. Gaskets: ASTM F 477, elastomeric seal.
- C. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
  - 1. Gaskets: ASTM F 477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being joined.

## **2.3 CLEANOUTS (LAMPHOLES) AND TEST WELLS**

- A. General: Where indicated on drawings, or where indicated by the local authority having jurisdiction, provide a vertical riser pipe from the sanitary sewer to the finished grade, the riser shall be the full size of the sanitary sewer or a minimum of 6 inch size for sanitary sewers over 6 inches in size. For cleanouts, the riser shall join the sanitary sewer at a 45 degree angle through a wye fitting; for test wells, the riser pipe shall join the storm sewer vertically through a tee fitting.

## **2.4 IDENTIFICATION**

- A. Metallic Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW".

## **PART 3 - EXECUTION**

### **3.1 PREPARATION OF FOUNDATION FOR BURIED SANITARY SEWERAGE SYSTEMS:**

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

### **3.2 PIPE APPLICATIONS FOR UNDERGROUND SANITARY SEWERS**

- A. Pipe Sizes 12 Inches and Smaller: PVC gasket joint sewer pipe and fittings.

### **3.3 INSTALLATION, GENERAL**

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- D. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.
- E. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.

### **3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION**

- A. Join and install PVC pipe as follows:
  - 1. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
  - 2. Installation in accordance with ASTM D 2321.

### **3.5 CLEANOUTS AND TEST WELLS**

- A. Install cleanouts and test wells from sewer pipe to manhole at grade as indicated. Set manhole frame and cover in concrete pad with minimum dimensions of 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of manhole 1 inch above surrounding earth grade or flush with grade when installed in paving.

### **3.6 TAP CONNECTIONS**

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6 inch overlap, with not less than 6 inches of 3000 psi 28 day compressive strength concrete.
- C. Make branch connections from side into existing 4 to 21 inch piping by removing section of existing pipe and installing wye fitting into existing piping. Encase entire wye with not less than 6 inches of 3000 psi 28 day compressive strength concrete.
- D. Make branch connections from side into existing 24 inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
  - 1. Provide concrete that will attain minimum 28 day compressive strength of 3000 psi, unless otherwise indicated.
  - 2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
- E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

### **3.7 INSTALLATION OF IDENTIFICATION**

- A. Install continuous plastic underground warning tape during backfilling of trench for underground sanitary piping. Locate 6 to 8 inches below finished grade, directly over piping.

### **3.8 FIELD QUALITY CONTROL**

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate report for each test.
  5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile (4.6 L/millimeter of nominal pipe size per kilometer) of pipe, during 24 hour period.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
    - f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
  6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6 and the following:
    - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
    - b. Option: Test concrete gravity sewer piping according to ASTM C924 (ASTM C 924M).
  7. Deflection Testing: In addition to the leakage test, the contractor shall furnish all labor, materials and equipment and perform a deflection test using a mandrel whose diameter is equal to 95% of the inside diameter of the pipe, manually pulled through the sewer line.
 

The mandrel shall have a minimum of eight legs, and shall test for inside diameter dimension 95% of those stated in ASTM D-3034.

Deflection tests shall be made on all sections of sewer.

Deflection of the pipe shall not exceed 5%.

Any section of pipe not meeting the deflection test shall be uncovered and "re-rounded" by re-compacting the bedding material, or by other means as required, and the pipe retested until it meets requirements.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

### 3.9 CLEANING

- A. Clean interior of piping of dirt and superfluous material.

**END OF SECTION 335100**