

# **PROJECT MANUAL AND SPECIFICATIONS**



**AGNES EDWARDS HALL**

**ROTC WING**

**AT**

**LAFAYETTE, LOUISIANA**

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## **SECTION 02 41 19 - SELECTIVE DEMOLITION**

### **PART 1 - GENERAL**

#### **1.1. RELATED DOCUMENTS**

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

#### **1.2. SUMMARY**

- A. This Section includes the following:
  - 1. Demolition and removal of selected site elements, curbs and/or paving.
  - 2. Patching and repairs.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 1 Section "Cutting and Patching" for cutting and patching procedures for selective demolition operations.
  - 2. Division 1 Section "Construction Facilities and Temporary Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for selective demolition operations.
  - 3. Division 1 Section "Closeout Procedures" and "Project Record Documents" for record document requirements.
  - 4. Division 21, 22 and 23 Sections for cutting, patching, or relocating mechanical items.
  - 5. Division 26, 27 and 28 Sections for cutting, patching, or relocating electrical items.
  - 6. Division 31 Section "Site Clearing" for site clearing and removing above- and below-grade improvements.
  - 7. Division 31 Earthwork Sections for soil materials, excavating, backfilling, and site grading.
  - 8. Division 32 Sections for Exterior Improvements.
  - 9. Division 33 Sections for Site Utilities and Storm Drainage.

#### **1.3. DEFINITIONS**

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers

and deliver to Owner's designated storage area.

- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Architect, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

#### 1.4. MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

#### 1.5. SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.
- B. Proposed dust-control measures.
- C. Proposed noise-control measures.
- D. Schedule of selective demolition activities indicating the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
  - 2. Interruption of utility services.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
- E. Inventory of items to be removed and salvaged.
- F. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by selective demolition operations.
- G. Record drawings at Project closeout according to Division 1 Section "Contract Closeout."
  - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

#### 1.6. QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having

jurisdiction.

- B. Pre-demolition Conference: Conduct conference at Project site to comply with preinstallation conference requirements of Division 1 Section "Project Meetings."

#### 1.7. PROJECT CONDITIONS

- A. Owner assumes no responsibility for actual condition of site elements to be selectively demolished.
  - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- B. Asbestos: It is not expected that asbestos will be encountered in the Work. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
- C. Storage or sale of removed items or materials on-site will not be permitted.

#### 1.8. SCHEDULING

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

### PART 2 - PRODUCTS

#### 2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
  - 1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 2. Use materials whose installed performance equals or surpasses that of existing materials.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict.

Promptly submit a written report to the Architect.

- E. Survey the condition of the item to be demolished to determine whether removing any element might result in structural deficiency of any portion of the structure or adjacent structures during selective demolition.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
  - 2. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Utility Requirements: Refer to Divisions 21, 22, 23, 26, and 33 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until any required utility disconnecting and sealing have been completed and verified in writing.

### 3.3 PREPARATION

- A. Conduct demolition operations and remove debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
- B. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective demolition area.
  - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
  - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
  - 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

### 3.4 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and



dirt. Comply with governing environmental protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
  2. Use suitable fabric material along entire length of coulee wall to prevent soil and debris from washing into the coulee during period of rain fall.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

### 3.5 SELECTIVE DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
  4. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

### 3.6 PATCHING AND REPAIRS

- A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.
- B. Patching is specified in Division 1 Section "Cutting and Patching."

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

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

END OF SECTION 02 41 19

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

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Exterior nonload-bearing steel-stud walls.
  - 2. Exterior Wall Rainscreen “Z” Furring Channels.
  - 3. Exterior steel-stud soffit and/or ceiling framing.
  - 4. Interior miscellaneous framing members for walls, openings and/or ceiling applications where noted.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 4 Section “Unit Masonry” for masonry veneers.
  - 2. Division 9 Section "Gypsum Board Assemblies" for gypsum board and light-gauge metal-stud framing and ceiling-suspension assemblies.
  - 3. Division 9 Section "Gypsum Sheathing" for gypsum sheathing applied to exterior steel framing.

#### **1.3 PERFORMANCE REQUIREMENTS**

- A. AISI "Specifications": Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members" or "Load and Resistance Factor Design Specification for Cold-Formed Steel Structural Members" and the following:
- B. Center for Cold-Formed Steel Structures (CCFSS) Technical Bulletin, Vol. 2, No. 1, February 1993 "AISI Specification Provisions for Screw Connections."
- C. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
- D. Design and size components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with the requirements of the International Building Code, 2021 edition and ASCE 7-16 “Minimum Design Loads for Buildings and Other Structures”. For design of framing system for support of metal wall and/or ceiling areas,

design shall consider the following applicable items:

1. Wind loading.
2. Particular zone of the building, as well as Components and Cladding Sections of the International Building Code and ASCE 7-16.
3. Thru-wall (or ceiling) openings, changes of direction, etc.

**Refer to Structural Drawings for specific requirements that apply to required design loads for walls and other component loads for this project.**

E. Design framing systems to withstand design loads without deflections greater than the following:

1. Exterior Walls: Lateral Deflection of  $L/600$  of the wall height.
2. Exterior Ceiling Joist Framing: Vertical Deflection of  $L/360$  of the span.
3. Interior Walls, Ceilings and Framing: Lateral and/or Vertical Deflection of  $L/360$  of the wall and/or ceiling height/span.

F. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 deg F (67 deg C).

G. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

H. Design exterior nonload-bearing wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.

I. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, connection details, and other structural data. **Shop Drawings must be stamped by a licensed Professional Engineer responsible for their preparation.**

#### 1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of cold-formed metal framing, accessory, and product specified.

C. Shop drawings showing layout, spacings, sizes, thicknesses, and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of Work.

D. For cold-formed metal framing indicated to comply with certain design loadings, include structural

analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

- E. Mill certificates signed by manufacturers of cold-formed metal framing certifying that their products comply with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, and galvanized-coating thickness.
  - 1. In lieu of mill certificates, submit test reports from a qualified independent testing agency evidencing compliance with requirements.
- F. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
- G. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."
- C. Fire-Test-Response Characteristics: Where fire-resistance-rated assemblies are indicated, provide cold-formed metal framing identical to that tested as part of an assembly for fire resistance per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of cold-formed metal framing similar to this Project in material, design, and extent and that have a record of successful in-service performance.
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid

condensation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide cold-formed metal framing by one of the following:
  - 1. Clark-Dietrich Industries, Inc.
  - 2. MBA Metal Framing
  - 3. Southeastern Metals, SEMCO
  - 4. Telling Industries
  - 5. Steel Structural Products LLC

### 2.2 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A 446 (ASTM A 446M), zinc coated according to ASTM A 525 (ASTM A 525M), and as follows:
  - 1. Coating Designation: G 60 (Z 180) or G 90 (Z 275).
  - 2. Grade: As required by structural performance.

### 2.3 WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs of web depths indicated, with lipped flanges, and complying with the following:
  - 1. Un-coated-Steel Thickness: 18 gauge minimum or as required for structural performance.
  - 2. Flange Width: 1-5/8 inches, minimum.
  - 3. Web: Punched unless un-punched required for structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, un-punched, of web depths indicated, with straight flanges, and complying with the following:
  - 1. Un-coated-Steel Thickness: Matching steel studs.
  - 2. Flange Width: Manufacturers standard deep flange where indicated or required for wind loading specified, standard flange elsewhere.
- C. Exterior Rainscreen Z-Girts: Manufacturer's standard Z-shaped Rainscreen Framing members of web depths indicated with lipped flanges complying with the following:
  - 1. Un-coated-Steel Thickness: 16 gauge (54 mils) minimum or as required for structural performance. Rainscreen "Z-Girts" must have a G90 galvanized Coating.
  - 2. Flange Width: 1-1/2 inches minimum with pre-punched holes at 4" on center and "toed-in" leg for strength and to grip rigid insulation.

3. Web: 2" depth with Slotted Holes in web for moisture weeping.

## 2.4 FLOOR OR CEILING FRAMING

- A. Joist Framing: Manufacturer's standard C-shaped steel joist, of web depths indicated or required with stiffened flanges, complying with ASTM C 955, and as follows:
  1. Un-coated-Steel Thickness: 18 gauge minimum or as required for structural performance.
  2. Flange Width: 1-5/8 inches, minimum.
  3. Web: Punched unless un-punched required for structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, un-punched, of web depths indicated, with straight flanges, and complying with the following:
  1. Un-coated-Steel Thickness: Matching steel studs.
  2. Flange Width: Manufacturers standard deep flange.

## 2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
  1. Supplementary framing.
  2. Bracing, bridging, and solid blocking.
  3. Web stiffeners.
  4. Stud kickers and girts.
  5. Reinforcement plates.

## 2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36 (ASTM A 36M), zinc coated by the hot-dip process according to ASTM A 123.
- B. Cast-in-Place Anchor Bolts and Studs: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon-steel hex-head bolts and studs; carbon-steel nuts; and flat, unhardened-steel washers. Zinc coated by the hot-dip process according to ASTM A 153.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times the design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- D. Powder-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10

times the design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

## 2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

## 2.8 GYPSUM SHEATHING AND DRYWALL

A. Sheathing and Drywall: Comply with requirements of Division 9 Sections "Gypsum Sheathing" and "Gypsum Board Assemblies".

## 2.9 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.

1. Fabricate framing assemblies in jig templates.

2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to manufacturer's recommendations.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.

C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of

sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting substrates and abutting structural framing for compliance with requirements, including installation tolerances and other conditions affecting performance of cold-formed metal framing. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
  1. Cut framing members by sawing or shearing; do not torch cut.
  2. Fasten cold-formed metal framing members by welding or screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
    - a. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    - b. Locate mechanical fasteners and install according to cold-framed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- C. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- D. Provide temporary bracing and leave in place until framing is permanently stabilized.
- E. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- F. Install insulation in built-up exterior framing members, such as headers, sills, boxed joists, and double studs, inaccessible upon completion of framing work.
- G. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.
- H. Erection Tolerances: Install cold-formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet (1:960) and as follows:



1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.3 NONLOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Squarely seat studs against webs of top and bottom tracks. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
  1. Stud Spacing: 16 inches (406 mm) maximum except closer as required for structural performance specified.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate steel framing from building structure at locations indicated to prevent transfer of vertical loads while providing lateral support.
  1. Connect studs with vertical slide clips to continuous angles or supplementary framing anchored to building structure where indicated.
- E. Install horizontal bridging in wall studs, spaced in rows not more than 72 inches apart. Fasten at each stud intersection.
  1. Bridging: Cold-rolled steel channel, clip angle fastened to webs of punched studs.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

### 3.4 JOIST INSTALLATION

- A. Install continuous tracks sized to match joist. Align tracks accurately and securely anchor to supporting structure. Install joist bearing (or hanging) from supporting frame, level, straight, and plumb; adjust to final position, brace and reinforce. Fasten to both flanges of joist track.
  1. Joist Spacing: 16 inches (406 mm) maximum except closer as noted or required for structural performance specified.
- B. Isolate steel framing from building structure at locations indicated to prevent transfer of loads while providing lateral support.
- C. Install bridging in joist, spaced in rows not more than 72 inches apart and as indicated on shop drawings.
  1. Bridging: Cold-rolled steel channel, clip angle fastened to webs of punched studs.

- D. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

### 3.5 GYPSUM INSTALLATION

- A. General: Install gypsum sheathing and board according to “Gypsum Sheathing” and “Gypsum Board Assemblies” specifications specified in Division 9.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.
- B. Field and shop welds will be subject to inspection and testing.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Remove and replace Work that does not comply with specified requirements.
- E. Additional testing if required will be performed to determine compliance of corrected Work with specified requirements. Contractor shall pay for all retesting.

### 3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanizing repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer to ensure that cold-formed metal framing is without damage or deterioration at the time of Substantial Completion.

END OF SECTION 05 40 00

## **SECTION 06 11 00 - ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Framing with dimension lumber.
  - 2. Rooftop equipment bases and support curbs.
  - 3. Wood blocking and nailers.
  - 4. Plywood backing panels.
- B. Related Sections:
  - 1. Division 6 Section "Sheathing" for wood sheathing materials.

#### **1.3 DEFINITIONS**

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NLGA: National Lumber Grades Authority.
  - 2. SPIB: The Southern Pine Inspection Bureau.
  - 3. WWPA: Western Wood Products Association.

#### **1.4 SUBMITTALS**

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

3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preserved-treated wood. Powder-actuated fasteners.
  2. Fire-retardant-treated wood. Expansion anchors.
  3. Engineered wood products. Metal framing anchors.
  4. Power-driven fasteners.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

# PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

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

## 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Wood Treatment by Pressure Process

- B. General: Where lumber or plywood is indicated as preservative-treated wood or is specified herein to be treated, comply with applicable requirements of AWWPA Standards C2 (Lumber) and C9 (Plywood). Note: Preservative treatments conforming to AWWPA Listings for MCA as deemed appropriate for exposure and application intended, are acceptable as approved by Architect for each use identified for the specific product. Mark each treated item with the AWPB or SPIB Quality Mark Requirements. MCQ and ACQ Type treatments are not acceptable for use on this project.
- C. Pressure-treat above-ground items with water-borne preservatives to a minimum retention of 0.06 pcf. Kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Do not use material that is warped or does not comply with requirements of untreated material.
- D. Pressure-treat wood members in contact with the ground or fresh water with water-borne preservatives to a minimum retention of 0.15 pcf.
- E. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWWPA M4 using copper naphthenate solution (2% copper). Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.
- F. Application: Treat items indicated on Drawings, 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 and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  - 4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

## 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 

|  |         |
|--|---------|
| 1. Blocking                                  | Cants   |
| 2. Nailers                                   | Furring |
| 3. Rooftop equipment bases and support curbs | Grounds |
- B. For items of dimension lumber size, provide Standard, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and the following species:

1. Mixed Southern Pine; SPIB.
  - C. 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.
  - D. 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.
- 2.4 PLYWOOD BACKING PANELS
- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch 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 of AISI Type 304 stainless steel or hot-dipped galvanized per ASTM 153 and/or ASTM A 653 (Class G185).
  - 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 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
    1. Interior Exposure Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
    2. Exterior Exposure 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).

H. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G90 coating designation.

1. Use for interior locations where not in contact with treated lumber or where stainless steel is not indicated.

I. Stainless-Steel Sheet: ASTM A 666, Type 304, or 316L

1. Use for exterior locations, in contact with treated lumber, and where indicated.

## 2.6 MISCELLANEOUS MATERIALS

A. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWWA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  1. Use inorganic boron for items that are continuously protected from liquid water.
  2. Use copper naphthenate for items not continuously protected from liquid water.
- F. 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.

- G. Use common wire 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; do not countersink nail heads, unless otherwise indicated.

### 3.2 WOOD 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.

END OF SECTION 06 11 00



## **SECTION 06 20 20 - INTERIOR FINISH 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. Interior standing and running trim and/or rails.
  - 2. Interior plywood panels.

- B. Related Requirements:

- 1. Division 6 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
  - 2. Division 6 Section "Interior Architectural Woodwork" for Interior Wood and/or Plastic Laminate Cabinets, Millwork, Trim, and Solid Surface Countertops.
  - 3. Division 9 Section "Painting" for staining, priming, painting and/or back-priming of interior finish carpentry.

#### **1.3 DEFINITIONS**

- A. MDF: Medium-density fiberboard.
- B. MDO: Plywood with a medium-density overlay on the face.

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors 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. Include chemical-treatment manufacturer's written instructions for finishing treated material.
  - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
- B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.
- C. Samples for Verification:
  1. For each species and cut of lumber and panel products with non-factory-applied finish, with half of exposed surface finished, 50 sq. in. for lumber and 8 by 10 inches for panels.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
- B. Sample Warranty: For manufacturer's warranty.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
  1. Indications that materials are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the American

Lumber Standard Committee's Board of Review. Grade lumber by an agency certified by the American Lumber Standard Committee's 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, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

## 2.2 INTERIOR TRIM

A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Clear White Maple.
2. Maximum Moisture Content: Maximum 13 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Only allowed for lumber trim wider than 8 inches.
5. Veneered Material: Not allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine, Finish or 1 Common (Colonial)
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Allowed.
4. Face Surface: Surfaced (smooth).

## 2.3 PLYWOOD PANELS

A. Hardwood Veneer Plywood Panels: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1 for transparent finish (Stain or clear finish).

1. Face Veneer Species and Cut: Plain-sliced White Maple
2. Veneer Matching: Selected for similar color and grain.
3. Backing Veneer Species: Any hardwood compatible with face species.
4. Construction: Veneer core.
5. Thickness: As indicated on the drawings.
6. Panel Size: 48 by 96 inches.
7. Glue Bond: Type II (interior).
8. Face Pattern: Plain
9. Finish: Field finished.

## 2.4 STAIR RAILINGS

- A. Interior Railings: Clear, kiln-dried hard white maple, of pattern indicated, either solid or laminated.

## 2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
- B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
- D. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.
- E. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

## 2.6 FABRICATION

- A. Back out or kerf backs of the following members, except those with ends exposed in finished work:
  - 1. Interior standing and running trim.
  - 2. Wood-board paneling.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

### 3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
  - 4. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
  - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

### 3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
  - 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
  - 2. Install trim after gypsum-board joint finishing operations are completed.
  - 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

### 3.5 PANEL INSTALLATION

- A. Plywood Panels: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Install with uniform tight joints between panels.

1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners and adhesive as recommended by panel manufacturer.
2. Conceal fasteners to greatest practical extent.
3. Fasten to supports with nails of type and at spacing recommended by panel manufacturer.

### 3.6 STAIR RAILING INSTALLATION

- A. Railings: Secure wall rails with metal brackets.

### 3.7 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

### 3.8 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes if any.

### 3.9 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
  1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 20 20

## **SECTION 08 11 10 - HOLLOW METAL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:

- 1. Standard hollow metal doors and frames.

- B. Related Sections:

- 1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
  - 2. Division 08 Section "Wood Doors" for wood doors in hollow metal frames.
  - 3. Division 08 Section "Door Hardware" for door hardware for hollow metal doors and frames.
  - 4. Division 09 Sections "Painting" for field painting hollow metal doors and frames.

#### **1.3 DEFINITIONS**

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.

C. Samples for Verification:

1. Samples are only required by request of the architect and for manufactures that are not current members of Steel Door Institute.
2. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
3. For the following items, prepared on Samples about 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
  - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
  - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Label each individual glazed lite.
- D. Smoke-Control Door Assemblies: Comply with NFPA 105.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
  1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.



## 1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with this section requirements, provide products by one of the following:
  - 1. Amweld Building Products, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.
  - 4. Steelcraft; an Allegion company.
  - 5. Mesker Door, Inc.
  - 6. Substitutions; only material from an SDI member will be allowed on the jobsite unless prior approval is given in accordance with substitution request requirements per General Requirements section.

### 2.2 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating for interior doors and frames and minimum G90 metallic coating at exterior doors and frames. **(Note all hollow metal doors and frames on this project require galvanized Metallic Coating as noted above.)**
- B. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
  - 1. For anchors built into masonry walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. Glazing: Comply with requirements in Division 08 Section "Glazing."

### 2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide 1 3/4" thick beveled and handed doors of design indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  - 1. Design: Flush panel

2. Core Construction: Manufacturer's standard polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
    - a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
  3. Vertical Edges for Single-Acting Doors: Beveled edge
    - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
  4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
  5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheets. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
- C. Interior Doors: Face sheets fabricated from metallic-coated sheets. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
1. Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm-) thick steel, Model 2 (Seamless face and edges).
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheets.
1. Fabricate frames with mitered or coped corners.
  2. Fabricate frames as face welded joints and back weld joints continuously, unless otherwise indicated.
  3. Frames for Level 3 Steel Doors: minimum 14 gauge 0.067-inch- (1.7-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled metallic-coated sheets.
1. Fabricate frames with mitered or coped corners.

2. Fabricate frames as face welded. Knock down frames are not acceptable on this project.
3. Frames for Level 3 Steel Doors: minimum 14 gauge 0.067-inch- (1.7-mm-) thick steel sheet.
4. Frames for Wood Doors: minimum 16 gauge 0.053-inch- (1.3-mm-) thick steel sheet.
5. Frames 48-inches and wider in opening width are required to be minimum 14 gauge 0.067-inch- (1.7-mm-) thick steel sheet.
6. Frames for Borrowed Lights: minimum 16 gauge 0.053-inch- (1.3-mm-) thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

## 2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.6 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

## 2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inches (0.4 mm) thick.

## 2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8
- C. Hollow Metal Doors:
  - 1. Exterior Doors:
    - a. Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Top of door to be flush and completely sealed joints in top edges of doors against water penetration.
  - 2. Glazed Lites: Factory cut openings in doors with applied flush trim to fit.
  - 3. Astragals: Provide overlapping astragal as noted in door hardware sets in Division 8 Door Hardware on one leaf of pairs of doors where required by NFPA 80 for fire- performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
  - 4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
  - 5. Seamless Edge: Provide seamless edge on hollow metal doors by intermittently tack welding seam, grinding smooth and finishing edge free from defects and blemishes.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Continuously backweld joints at exterior frames.
  - 2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 3. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops required wider dimension on glass side of frame.
  - 4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 42-inch and wider with mortise/butt type hinges only at top hinge location to deter against hinge reinforcement sag.
  - 5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 8 Door Hardware.
  - 6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops; provide security head screws at exterior locations.
  - 7. Grout Guards: Weld guard boxes to frame at back of mortise hardware prep in frames at all hinge, strike and other recessed hardware preps regardless of grouting requirements.
  - 8. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
      - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches

(610 mm) or fraction thereof above 120 inches (3048 mm) high.

- b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
  - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
  - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
  - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
  - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
  - 5) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
- 9. Door Silencers: Except on weather-stripped or gasketed doors, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers to be supplied by frame manufacture regardless if specified in division 8 Door Hardware.
  - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
  - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
  - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
  - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  - 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 – 28 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricators shop
  - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  - 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that glazed lites are capable of being removed independently.
  - 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  - 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
  - 5. Gap for butted or mitered joints in glass stop should not exceed .0625-inch.

## 2.9 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
  - a. At fire-protection-rated openings, install frames according to NFPA 80.
  - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
  - c. Install frames with removable glazing stops located on secure side of opening.
  - d. Install door silencers in frames before grouting.
  - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
  - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors.
  - a. Floor anchors may be set with powder-actuated fasteners instead of post installed expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. Field Supplied Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
7. Grouting Requirements:
  - a. Do not grout head of frames unless reinforcing has been installed in head of frame.
  - b. Do not grout vertical or horizontal closed mullion members.
8. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs

- on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.
    - a. Secure exterior removable stops with security head screws.

#### 3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 10



## **SECTION 08 21 10 - FLUSH WOOD DOORS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Solid-core wood doors with factory finish/stained veneer.
  - 2. Factory fitting flush wood doors to frames and factory machining for hardware.
  - 3. Factory finishing flush wood doors.
- B. Related Sections include the following:
  - 1. Division 8 Section "Glazing" for glass view panels in flush wood doors.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of door. Include details of core and edge construction, trim for openings, and louvers.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  - 1. Indicate fire ratings for fire doors.
- C. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
  - 1. Manufacturer's Standard Stain Color Selection Chart on actual species of wood indicated in manufacturer's standard sample size.
- D. Samples for Verification: As follows:
  - 1. Corner sections of doors approximately 8 by 10 inches (200 by 250 mm) with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors.
  - 2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with the following standard:
  - 1. NWWDA Quality Standard: NWWDA I.S.1-A, "Architectural Wood Flush Doors."
  - 2. AWI Quality Standard: AWI's "Architectural Woodwork Quality Standards" for grade of door, core, construction, finish, and other requirements.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  - 1. Temperature-Rise Rating: At stairwell enclosures, provide doors that have a temperature-rise rating in accordance with applicable code requirements.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors during transit, storage, and handling to prevent damage, soiling, and deterioration. Comply with requirements of referenced standard and manufacturer's written instructions.
  - 1. Individually package doors in plastic bags or cardboard cartons.
- B. Mark each door with individual opening numbers used on Shop Drawings. Use removable tags or concealed markings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with requirements of the referenced quality standard for Project's geographical location.

#### 1.7 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form, signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup, or twist) more than 1/4 inch (6.35 mm) in a 42-by-84-inch (1067-by-2134-mm) section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 75-mm) span, or do not comply with tolerances in referenced quality standard.

C. Warranty shall be in effect during the following period of time after the date of Acceptance:

1. Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flush Wood Doors:
  - a. Ampco Products, Inc.
  - b. Beull Door Company, Inc.
  - c. Chappell Door Co.
  - d. Eggers Industries
  - e. Ideal Architectural Doors
  - f. Marlite.
  - g. V-T Industries Inc.
  - h. Marshfield Door Systems, Inc.

### 2.2 DOOR CONSTRUCTION, GENERAL

A. Solid-core Doors: Comply with the following requirements:

1. Doors for Transparent Finish: Comply with the following requirements:
  - a. Faces: White Maple, rift or plain sliced, straight vertical grain.
  - b. Grade: Custom.
  - c. Construction: Minimum 5 plies.
  - d. Core: Structural Composite Wood DCL or Staved Lumber Core SLC-HPDL. Doors must have bonded cores. (Particle board cores are not acceptable for use on this project)
  - e. Bonding: Stiles and rails bonded to core, then entire unit abrasive planed before veneering.
  - f. Stain Color: As selected by Architect from manufacturers standards.

B. Fire-Rated Doors: Comply with the following requirements:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated and as follows:
  - a. 5-inch (125-mm) top-rail blocking.
  - b. 5-inch (125-mm) bottom-rail blocking, at doors indicated to have kick, mop, or armor plates.
  - c. 4-1/2-by-10-inch (114-by-250-mm) lock blocks.

- d. 5-inch (125-mm) midrail blocking, at doors indicated to have exit devices.
- 3. Edge Construction: Provide manufacturer's standard laminated-edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.
- 4. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.

## 2.3 WOOD LOUVERS AND FRAMES

- A, Wood Louvers and Frames for Louver Openings in Wood Doors: Door Manufacturer's standard solid wood louvers with wood frames/stops unless otherwise indicated. Wood Species and factory finish to match that of door faces.

## 2.4 LIGHT FRAMES

- A. Metal Frames for Light Openings in Doors: Manufacturer's standard frame formed of 0.0478-inch thick, cold-rolled steel sheet, factory primed and approved for use in doors of fire rating indicated.

## 2.5 FABRICATION

- A. Fabricate flush wood doors in sizes indicated for Project site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
  - 1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements of NFPA 80 for fire-rated doors.
- C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  - 2. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- D. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.

## 2.6 FACTORY FINISHING (Wood Veneer Faced Doors)

- A. Comply with referenced quality control standard for factory finishing. Complete fabrication including fitting doors for openings and machining for hardware that is not surface applied prior to finishing.

1. Factory Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cut-outs and mortises.
- B. Transparent Finish:
1. Grade: Premium
  2. Finish: AWI Conversion Varnish or Catalyzed Polyurethane
  3. Staining: As selected from Manufacturer's full range
  4. Effect: Filled Finish
  5. Sheen: Satin

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine installed door frames before hanging doors.
1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Manufacturer's Written Instructions: Install wood doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
- C. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

### 3.3 ADJUSTING AND PROTECTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08 21 10

## SECTION 08 41 13 - ALUMINUM ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following types of aluminum entrance and storefrontwork:
  - 1. Interior and Exterior entrance doors.
  - 2. Transoms.
  - 3. Sidelights.
  - 4. Frames for entrances.
  - 5. Interior and Exterior Storefront-type framing system.
- B. Related Sections: The following sections contain requirements that relate to this Section:
  - 1. Division 8 Section "Flush Wood Doors" for interior wood doors to be installed in aluminum entrance frames, if applicable.
  - 2. Division 8 Section "Glazed Aluminum Curtain Walls" for aluminum curtain wall framing.
  - 3. Division 8 Section "Aluminum Ventilator Windows" for Aluminum Ventilator Access Window to be integrated into Aluminum Storefront Framing System.
  - 4. Glazing requirements for aluminum entrances and storefront, including entrances specified to be factory glazed, are included in Division 8 Section "Glass and Glazing."
  - 5. Door Hardware for Entrances are included in Division 8 Section "Door Hardware."

#### 1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum entrance and storefront assemblies that comply with performance characteristics specified, as demonstrated by testing the manufacturer's corresponding stock assemblies according to test methods indicated.
- B. Thermal Movement: Design the aluminum entrance and storefront framing systems to provide for expansion and contraction of the component materials. Entrance doors shall function normally over the specified temperature range.
  - 1. The system shall be capable of withstanding a metal surface temperature range of 180 deg F (100 deg C) without buckling, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, stress on glass, or other detrimental effects.
- C. Design Requirements: Provide aluminum entrance and storefront systems that comply with

structural performance, air infiltration, and water penetration requirements indicated.

1. Wind Loads: Provide aluminum entrance and storefront assemblies capable of withstanding wind pressures calculated according to requirements of the International Building Code, latest state adopted edition or the American Society of Civil Engineers, ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," whichever is more stringent. Wind design speed for this project is per the drawings.
- D. Structural Performance: Conduct tests for structural performance in accordance with ASTM E 330. At the conclusion of the tests there shall be no glass breakage or permanent damage to fasteners, anchors, hardware or actuating mechanism. Framing members shall have no permanent deformation in excess of 0.2 percent of their clearspan.
1. Deflection Normal to the Plane of the Wall: Test pressure required to measure deflection of framing members normal to the plane of the wall shall be equivalent to the wind load specified above. Deflection shall not exceed 1/175 of the clear span or 3/4" maximum, when subjected to uniform load deflection test except 1/360, 3/4" maximum where plaster or gypsum board surfaces are subject to bending.
  2. Deflection Parallel to the Plane of the Wall: Test pressures required to measure deflection parallel to the plane of the wall shall be equal to 1.5 times the wind pressures specified above. Deflection of any member carrying its full dead load shall not exceed an amount that will reduce glass bite below 75 percent of the design dimension and shall not reduce the edge clearance between the member and the fixed panel, glass or other fixed member above to less than 1/8 inch. The clearance between the member and an operable door or window shall be at least 1/16 inch.
- E. Air Infiltration: Provide aluminum entrance and storefront framing system with an air infiltration rate of not more than 0.06 CFM per sq. ft. of fixed area (excluding operable door edges) when tested in accordance with ASTM E 283 at an inward test pressure differential of 1.57 psf.
- F. Water Penetration: Provide framing systems with no uncontrolled water penetration (excluding operable door edges) as defined in the test method when tested in accordance with ASTM E 331 at an inward test pressure differential of 6.24 lbf persq. ft.
- G. Condensation Resistance: Where framing systems are "thermal-break" construction (all locations with insulated glass), provide units tested for thermal performance in accordance with AAMA 1503 showing condensation resistance factor (CRF) of not less than 45.

#### 1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
1. Product data for each aluminum entrance and storefront system required, including:
    - a. Manufacturer's standard details and fabrication methods.
    - b. Data on finishing, hardware and accessories.
  2. Recommendations for maintenance and cleaning of exterior surfaces.

- B. Shop drawings for each aluminum entrance and storefront system required, including:
  - 1. Layout and installation details, including relationship to adjacent work.
  - 2. Elevations at 1/4-inch scale.
  - 3. Detail sections of typical composite members.
  - 4. Anchors and reinforcement including required fastener types and spacing.
  - 5. Hardware mounting heights (including for specified hardware provided by others).
  - 6. Provisions for expansion and contraction.
  - 7. Glazing details.
  - 8. **For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.**
- C. Hardware Schedule: Submit complete hardware schedule organized into sets based on hardware specified to be provided as part of this section. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Include item name, name of the manufacturer and complete designations of every item required for each door opening. Provide manufacturer cut sheets for each hardware item.
- D. Samples for Initial Color Selection: Submit pairs of samples of each specified color and finish on 12-inch-long sections of extrusions or formed shapes. Where normal color variations are anticipated, include 2 or more units in each set of samples indicating extreme limits of color variations.
- E. Test Reports: Provide certified test reports from a qualified independent testing laboratory showing that aluminum entrance and storefront systems have been tested in accordance with specified test procedures and comply with performance characteristics indicated.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed installations of aluminum storefront and entrances similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.
- B. Manufacturer's Qualifications: Provide aluminum entrances and storefront systems produced by a firm experienced in manufacturing systems that are similar to those indicated for this project and that have a record of successful in-service performance.
- C. Single Source Responsibility: Obtain aluminum entrance and storefront systems from one source and from a single manufacturer.
- D. Design Criteria: The drawings indicate the size, profile, and dimensional requirements of aluminum entrance and storefront work required and are based on the specific types and models indicated. Aluminum entrance and storefront by other prior approved manufacturers may be considered, provided deviations in dimensions and profiles are minor and do not change the



design concept as judged by the Architect. The burden of proof of equality is on the proposer.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aluminum entrance and storefront components in the manufacturer's original protective packaging.
- B. Store aluminum components in a clean dry location away from uncured masonry or concrete. Cover components with waterproof paper, tarpaulin or polyethylene sheeting in a manner to permit circulation of air.
  - 1. Stack framing components in a manner that will prevent bending and avoid significant or permanent damage.

#### 1.7 PROJECT CONDITIONS

- A. Field Measurements: Check openings by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of the work.
  - 1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

#### 1.8 WARRANTY

- A. Warranty: Submit a written warranty, executed by the manufacturer, agreeing to repair or replace units that fail in materials or workmanship within the specified warranty period. Failures include, but are not necessarily limited to:
  - 1. Structural failures including excessive deflection, excessive leakage or air infiltration.
  - 2. Faulty operation.
  - 3. Deterioration of metals, metal finishes and other materials beyond normal weathering.
- B. Warranty Period: 2 years after the date of Substantial Completion.
  - 1. The warranty shall not deprive the Owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering entrance and storefront systems that may be incorporated in the work include, the following:

#### 2.2 ALUMINUM ENTRANCES AND STOREFRONTS:

- A. **Basis of Design:** Kawneer Company, Inc. Trifab VersaGlaze 601 Framing System at Exterior and Trifab VersaGlaze 450 Framing System at Interior
- B. United States Aluminum Corp.
- C. Oldcastle Building Envelope
- D. YKK AP America
- E. Tubelite, Inc.

**NOTE: MANUFACTURER OF ALUMINUM ENTRANCES AND STOREFRONTS MUST BE SAME AS MANUFACTURER SELECTED FOR FURNISHING ALUMINUM VENTILATOR WINDOWS AND ALUMINUM CURTAIN WALL SYSTEMS SPECIFIED ELSEWHERE.**

## 2.3 MATERIALS

- A. Aluminum Members: Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for aluminum extrusions, ASTM B 209 for aluminum sheet or plate, and ASTM B 211 for aluminum bars, rods and wire.
- B. Carbon steel reinforcement of aluminum framing members shall comply with ASTM A 36 for structural shapes, plates and bars, ASTM A 611 for cold rolled sheet and strip, or ASTM A 570 for hot rolled sheet and strip.
- C. Glass and Glazing Materials: Comply with requirements of "Glass and Glazing" section of these specifications.
- D. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, zinc plated steel, or other material warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components.
- E. Reinforcement: Where fasteners screw-anchor into aluminum members less than 0.125 inches thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts.
- F. Exposed Fasteners: Do not use exposed fasteners except for application of hardware. For application of hardware, use Phillips flat-head machine screws that match the finish of member or hardware being fastened.
- G. Concealed Flashing: 0.0179-inch (26 gage) minimum dead-soft stainless steel, or 0.026-inch-thick minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.
- H. Brackets and Reinforcements: Provide high-strength aluminum brackets and reinforcements; where use of aluminum is not feasible provide nonmagnetic stainless steel or hot-dip galvanized steel complying with ASTM A 123.
- I. Concrete and Masonry Inserts: Provide cast iron, malleable iron, or hot-dip galvanized steel inserts complying with ASTM A 123.
- J. Compression Weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

- K. Sliding Weatherstripping: Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

## 2.4 HARDWARE

- A. General: Refer to Division 8 Section "Door Hardware" for requirements for hardware items other than those indicated to be provided by the aluminum entrance manufacturer.

## 2.5 COMPONENTS

- A. Storefront Framing System: Provide storefront and entrance framing systems fabricated from extruded aluminum members of size and profile indicated. Include subframes and other reinforcing members of the type indicated. Provide for flush glazing storefront from the exterior on all sides without projecting stops. Shop-fabricate and preassemble frame components where possible. Provide storefront frame sections without exposed seams.
  - 1. Mullion Configurations: Provide pockets at the inside glazing face to receive resilient elastomeric glazing. Mullions and horizontals shall be one piece. Make provisions to drain moisture accumulation to the exterior.
- B. Entrance Door Frames: Provide tubular and channel frame entrance door frame assemblies, as indicated, with welded or mechanical joints in accordance with manufacturer's standards. Reinforce as necessary to support required loads.
- C. Stile-and-Rail Entrance Doors: Provide tubular frame members, fabricated with mechanical joints using heavy inserted reinforcing plates and concealed tie-rods or j-bolts.
- E. Glazing: Fabricate doors to facilitate replacement of glass or panels, without disassembly of stiles and rails. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for nonremoval.
- F. Design: Provide 1-3/4-inch-thick doors of design indicated unless thicker doors are required for glazing indicated.
  - 1. Medium stile (3-1/2-inch nominal width).

## 2.6 FABRICATION

- A. General: Fabricate aluminum entrance and storefront components to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes and profile requirements are indicated on the drawings. Variable dimensions are indicated, with maximum and minimum dimensions required, to achieve design requirements and coordination with other work.
  - 1. Thermal-Break Construction: Fabricate storefront framing system with an integrally concealed, low-conductance thermal barrier, located between exterior materials and exposed interior members to eliminate direct metal-to-metal contact. Use manufacturer's standard construction that has been in use for similar projects for period of not less than 3 years.
- B. Prefabrication: Complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible before shipment to the Project site. Disassemble components only as

necessary for shipment and installation.

1. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. Complete these operations for hardware prior to application of finishes.
  2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
  3. Preglaze door and frame units to greatest extent possible.
- C. Welding: Comply with AWS recommendations. Grind exposed welds smooth to remove weld spatter and welding oxides. Restore mechanical finish.
1. Welding behind finished surfaces shall be performed in such a manner as to minimize distortion and discoloration on the finished surface.
- D. Reinforcing: Install reinforcing as required for hardware and as necessary for performance requirements, sag resistance and rigidity.
- E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or a suitable sealant, or a nonabsorptive plastic or elastomeric tape, or a gasket between the surfaces. Do not use coatings containing lead.
- F. Continuity: Maintain accurate relation of planes and angles with hairline fit of contacting members.
1. Uniformity of Metal Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.
- G. Fasteners: Conceal fasteners wherever possible.
- H. Weatherstripping: For exterior doors, provide compression weatherstripping against fixed stops. At other edges, provide sliding weatherstripping retained in adjustable strip mortised into door edge.
1. Provide EPDM or vinyl-blade gasket weatherstripping in bottom door rail, adjustable for contact with threshold.

## 2.7 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.

1. Fluoropolymer Coating System: Manufacturer's minimum 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
2. Color and Gloss: As selected by Architect from Manufacturer's full range of available colors and gloss levels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and supports, with the Installer present, for compliance with requirements indicated, installation tolerances, and other conditions that affect installation of aluminum entrances and storefronts. Correct unsatisfactory conditions before proceeding with the installation.
  1. Do not proceed with installation until unsatisfactory conditions are corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation.
- B. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Install components in proper alignment and relation to established lines and grades indicated. Provide proper support and anchor securely in place. Install Anodized Aluminum sub-sill flashing with turned up ends in continuous bed of sealant under all aluminum storefront framing system sills.
- C. Construction Tolerances: Install aluminum entrance and storefront to comply with the following tolerances:
  1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
  2. Offset from Alignment: The maximum offset from true alignment between two identical members abutting end to end in line shall not exceed 1/16 inch.
  3. Diagonal Measurements: The maximum difference in diagonal measurements shall not exceed 1/8 inch.
  4. Offset at Corners: The maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.
- D. Separate aluminum and other corrodible metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.
  1. Zinc or cadmium plate steel anchors and other unexposed fasteners after fabrication.
  2. Paint dissimilar metals where drainage from them passes over aluminum.

3. Paint aluminum surfaces in contact with mortar, concrete or other masonry with alkali resistant coating.
  4. Paint wood and similar absorptive material in contact with aluminum and exposed to the elements or otherwise subject to wetting, with two coats of aluminum house paint. Seal joints between the materials with sealant.
- E. Drill and tap frames and doors and apply surface-mounted hardware items. Comply with hardware manufacturer's instructions and template requirements. Use concealed fasteners wherever possible.
  - F. Set sill members and other members in bed of sealant as indicated, or with joint fillers or gaskets as indicated to provide weathertight construction. Comply with requirements of Division 7 for sealants, fillers, and gaskets.
  - G. Refer to "Glass and Glazing" Section of Division 8 for installation of glass and other panels indicated to be glazed into doors and framing.

### 3.3 ADJUSTING

- A. Adjust operating hardware to function properly, for smooth operation without binding, and for weathertight closure.

### 3.4 CLEANING

- A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.
- B. Clean glass surfaces after installation, complying with requirements contained in the "Glass and Glazing" Section for cleaning and maintenance. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

### 3.5 PROTECTION

- A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 41 13

## **SECTION 08 71 00 - DOOR HARDWARE**

### **PART 1 GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Hardware for fire-rated and non-fire rated doors.
- B. Electrically operated and controlled hardware.
- C. Lock cylinders for doors with balance of hardware specified in other sections.
- D. Thresholds.
- E. Weatherstripping and gasketing.

#### **1.02 RELATED REQUIREMENTS**

- A. Section 08 11 10 - Hollow Metal Doors and Frames.
- B. Section 08 21 10 - Flush Wood Doors.
- C. Section 08 41 13 – Aluminum Entrances and Storefronts.
- D. Section 08 42 00 – Fire Rated Steel Framed Entrance Doors.
- E. Section 28 10 00 - Access Control: Electronic access control devices.

#### **1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- C. BHMA A156.3 - Exit Devices; 2020.
- D. BHMA A156.4 - Door Controls - Closers; 2019.
- E. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- F. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- G. BHMA A156.7 - Template Hinge Dimensions; 2016.
- H. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
- I. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2021.
- J. BHMA A156.16 - Auxiliary Hardware; 2018.
- K. BHMA A156.19 - Power Assist and Low Energy Power Operated Swinging Doors; 2019.
- L. BHMA A156.21 - Thresholds; 2019.
- M. BHMA A156.22 - Standard for Gasketing; 2021.
- N. BHMA A156.26 - Standard for Continuous Hinges; 2021.
- O. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2018.
- P. BHMA A156.36 - Auxiliary Locks; 2020.
- Q. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2016.
- R. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- S. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

- T. DHI (KSN) - Keying Systems and Nomenclature; 2019.
- U. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- V. ITS (DIR) - Directory of Listed Products; Current Edition.
- W. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- X. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- Y. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- Z. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- AA. UL (DIR) - Online Certifications Directory; Current Edition.
- BB. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- CC. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- DD. UL 1034 - Standard for Safety Burglary-Resistant Electrical Locking Mechanisms; Current Edition, Including All Revisions.
- EE. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure facility services connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; require attendance by affected installers and the following:
  - 1. Architect.
  - 2. Installer's Architectural Hardware Consultant (AHC).
  - 3. Hardware Installer.
  - 4. Owner's Security Consultant.
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying Requirements Meeting:
  - 1. Attendance Required:
    - a. Owner.
    - b. Architect.
  - 2. Agenda:
    - a. Establish keying requirements.
    - b. Verify locksets and locking hardware are functionally correct for project requirements.
    - c. Verify that keying and programming complies with project requirements.
    - d. Establish keying submittal schedule and update requirements.
  - 3. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
    - a. Access control requirements.



- b. Key control system requirements.
- 4. 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.
- 5. Deliver established keying requirements to manufacturers.

#### 1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: A detailed listing that includes each item of hardware to be installed on each door.
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
  - 2. Comply with DHI (H&S) using door numbering scheme and hardware set numbers as indicated in Contract Documents.
    - a. Submit in vertical format.
  - 3. Include complete description for each door listed.
- D. Shop Drawings - Electrified Door Hardware: Include diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
  - 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
  - 2. Elevations: Include front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
  - 3. Diagrams: Include point-to-point wiring diagrams that show each device in door opening system with related colored wire connections to each device.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Supplier's qualification statement.
- I. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- J. Keying Schedule:
  - 1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- K. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- L. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- M. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

#### 1.06 QUALITY ASSURANCE

- A. Standards for Fire-Rated Doors: Maintain one copy of each referenced standard on site, for use by Architect and Contractor.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- D. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

#### 1.08 WARRANTY

- A. See Section 01 77 00 and 01 77 10 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
  - 1. Closers: Thirty five years, minimum.
  - 2. Locksets: Five years, minimum.
  - 3. Other Hardware: One year, minimum.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Closers:
  - 1. Provide door closer on each exterior door, unless otherwise indicated.
  - 2. Provide door closer on each fire-rated and smoke-rated door.
  - 3. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
- D. Drip Guards: Provide at head of outswinging exterior doors unless protected by roof or canopy directly overhead.
- E. Weatherstripping and Gasketing:
  - 1. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
  - 2. Provide door bottom sweep on each exterior door, unless otherwise indicated.
- F. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
- G. See Division 28 for additional access control system requirements.
- H. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
  - a. Aluminum fasteners are not permitted.
  - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
  - a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Provide wall grip inserts for hollow wall construction.
5. Fire-Resistance-Rated Applications: Comply with NFPA 80.
  - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
  - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.

## 2.02 PERFORMANCE REQUIREMENTS

- A. Provide door hardware products that comply with the following requirements:
  1. Applicable provisions of federal, state, and local codes.
  2. Accessibility: ADA Standards and ICC A117.1.
  3. Fire-Resistance-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
  4. Hardware on Fire-Resistance-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for application indicated.
  5. Hardware for Smoke and Draft Control Doors: Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
  6. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
  7. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
  8. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

## 2.03 HINGES

- A. Manufacturers: Conventional butt hinges.
  1. BEST; dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  2. Bommer.
  3. Hager Hinges Co.
  4. McKinney, Assa Abloy Group.
- B. Properties:
  1. Butt Hinges: As applicable to each item specified.
    - a. Standard Weight Hinges: Minimum of two (2) permanently lubricated non-detachable bearings.
    - b. Heavy Weight Hinges: Minimum of four (4) permanently lubricated bearings on heavy weight hinges.
    - c. Template screw hole locations.
    - d. Bearing assembly installed after plating.
    - e. Bearings: Exposed fully hardened bearings.

- f. Bearing Shells: Shapes consistent with barrels.
  - g. Pins: Easily seated, non-rising pins.
    - 1) Fully plate hinge pins.
    - 2) Non-Removable Pins: Slotted stainless steel screws.
  - h. UL 10C listed for fire-resistance-rated doors.
- 2. Continuous Hinges: As applicable to each item specified.
  - a. Pin and Barrel Continuous Hinges: As applicable to each item specified.
    - 1) Material: Fabricated from 14 gauge, 0.067 inch (1.7 mm) steel.
    - 2) Slim barrel design.
    - 3) Twin nylon self-lubricating bearings located between all knuckles except top and bottom.
    - 4) Two stainless steel bearings top and bottom, to prevent sagging if nylon bearings degrade during a fire.
- C. Sizes: See Door Hardware Schedule.
  - 1. Hinge Widths: As required to clear surrounding trim.
  - 2. Sufficient size to allow 180 degree swing of door.
- D. Finishes: See Door Hardware Schedule.
  - 1. Fully polish hinges; front, back, and barrel.
- E. Grades:
  - 1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
  - 2. Continuous Hinges: Comply with BHMA A156.26, Grade 1.
- F. Pin-and-Barrel Hinges Standards Compliance: UL and ULC listed for fire-resistance rated 4 foot (1219 mm) by 8 foot (2438 mm) single doors and 8 foot (2438 mm) by 8 foot (2438 mm) pairs up to 3 hours.
- G. Material: Base metal as indicated for each item by BHMA material and finish designation.
- H. Types:
  - 1. Butt Hinges: Include full mortise hinges.
  - 2. Continuous Hinges: Include geared and pin and barrel hinges.
- I. Options: As applicable to each item specified.
  - 1. Provide dutch door prep as listed in the hardware sets.
- J. Quantities:
  - 1. Butt Hinges: Three (3) hinges per leaves up to 90 inches (2286 mm) in height. Add one (1) for each additional 30 inches (762 mm) in height or fraction thereof.
    - a. Hinge weight and size unless otherwise indicated in hardware sets:
      - 1) For doors up to 36 inches (914 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.134 inch (3.4 mm) and a minimum of 4-1/2 inches (114 mm) in height.
      - 2) For doors from 36 inches (914 mm) wide up to 42 inches (1067 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.145 inch (3.7 mm) and a minimum of 4-1/2 inches (114 mm) in height.
      - 3) For doors from 42 inches (1067 mm) wide up to 48 inches (1219 mm) wide and up to 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
      - 4) For doors greater than 1-3/4 inches (44.5 mm) thick provide hinges with a minimum thickness of 0.180 inch (4.6 mm) and a minimum of 5 inches (127 mm) in height.
  - 2. Continuous Hinges: One per door leaf.
- K. Applications: At swinging doors.
- L. Provide non-removable pins at out-swinging doors with locking hardware and all exterior doors.

1. Butt Hinges:
  - a. Ball Bearing, Five (5) Knuckle.
2. Continuous Hinges.

## 2.04 BOLTS

- A. Manufacturers:
  1. Ives, Allegion Group.
  2. Rockwood, Assa Abloy Group.
  3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Properties:
  1. Flush Bolts:
    - a. Manual Flush Bolts: Manually latching upon closing of door leaf.
      - 1) Bolt Throw: 3/4 inch (19 mm), minimum.
  2. Dustproof Strikes: For bolting into floor, provide except at metal thresholds.
- C. Options:
  1. Extension Bolts: In leading edge of door, one bolt into floor, one bolt into top of frame.
- D. Products:
  1. Manual flush bolts.

## 2.05 EXIT DEVICES

- A. Manufacturers:
  1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  2. Sargent, Assa Abloy Group.
  3. Von Duprin, Allegion Group.
- B. Properties:
  1. Actuation: Full-length touchpad.
  2. Touchpads: 'T' style metal touchpads and rail assemblies with matching chassis covers end caps.
  3. Latch Bolts: Stainless steel deadlocking with 3/4 inch (19 mm) projection using latch bolt.
  4. Lever Design: Match project standard lockset trims.
  5. Cylinder: Include where cylinder dogging or locking trim is indicated.
  6. Strike as recommended by manufacturer for application indicated.
  7. Sound dampening on touch bar.
  8. Dogging:
    - a. Fire-Resistance-Rated Devices: Manual dogging not permitted.
  9. Touch bar assembly on wide style exit devices to have a 1/4 inch (6.3 mm) clearance to allow for vision frames.
  10. All exposed exit device components to be of architectural metals and "true" architectural finishes.
  11. Handing: Field-reversible.
  12. Fasteners on Back Side of Device Channel: Concealed - exposed fasteners not allowed.
  13. Vertical Latch Assemblies' Operation: Gravity, without use of springs.
- C. Grades: Complying with BHMA A156.3, Grade 1.
  1. Provide exit devices tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.

- D. Options:
  - 1. Internally mounted switch used to signal other components.
  - 2. MLR: Motorized latch retraction.
- E. Products:
  - 1. 2000 Series

## 2.06 REMOVABLE MULLIONS

- A. Manufacturers:
  - 1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 2. Sargent, Assa Abloy Group.
  - 3. Von Duprin, Allegion Group.
- B. Properties:
  - 1. Rectangular shape 3 inches (76 mm) by 2 inches (51 mm) tubes with minimum 1/8 inch (3.2 mm) wall thickness.
  - 2. Furnished by the same manufacturer as exit devices.
  - 3. Pre-drilled holes for installation of exit device strikes.
  - 4. Spacers: Provide as required for proper installation, based on frame profile and dimensions.
- C. Grades: Complying with BHMA A156.3.
- D. Materials: Manufacturer's standard for items specified.
  - 1. Top and Bottom Brackets: Investment-cast steel.
- E. Options:
  - 1. Furnish Keyed Removable "KR" feature and corresponding cylinders as specified.
    - a. Mullions capable of being installed without physical key present.
    - b. Physical key required to operate.
- F. Applications: As indicated on drawings and in Door Hardware Schedule.
  - 1. Fire-Resistance-Rated Openings: Mullions with UL Listed Labels and mullion stabilizers.
- G. Products:
  - 1. 822 Series.

## 2.07 ELECTRIC STRIKES

- A. Manufacturers:
  - 1. HES, Assa Abloy Group.
  - 2. RCI; dormakaba Group: [www.dormakaba.com/us-en/#sle](http://www.dormakaba.com/us-en/#sle).
  - 3. Schlage, Allegion Group.
- B. Properties:
  - 1. Provide UL (DIR) listed burglary-resistant devices.
  - 2. Provide UL 1034 compliant devices.
  - 3. Provide UL 10C compliant devices.
  - 4. Non-handed devices suitable for door frame material and scheduled lock configuration.
  - 5. Include transformer and rectifier as necessary for complete installation.
  - 6. Holding Force: 1,500 lbs (680.4 kg).
  - 7. Accommodating latch projections of 1/2 inch (13 mm) or 5/8 inch (16 mm).
- C. Options: As applicable to each item specified.
  - 1. Voltage: 24 VDC.

- D. Installation: Connect electric strikes into fire alarm where non-rated doors are scheduled to release with fire or sprinkler alarm condition.
- E. Products:
  - 1. F1 Series (F1114, F1119).
  - 2. F2 Series (F2164, F2366).

## 2.08 LOCK CYLINDERS

- A. Manufacturers:
  - 1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 2. Sargent, Assa Abloy Group.
  - 3. Schlage, Allegion Group.
- B. Properties:
  - 1. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
    - a. Provide cylinders from same manufacturer as locking device.
    - b. Provide cams and/or tailpieces as required for locking devices.
    - c. Provide cylinders with appropriate format interchangeable cores where indicated.
- C. Grades:
  - 1. Standard Security Cylinders: Comply with BHMA A156.5.
- D. Material:
  - 1. Manufacturer's standard corrosion-resistant brass alloy.
- E. Types: As applicable to each item specified.
- F. Applications: At locations indicated in hardware sets, and as follows
  - 1. As required for items with locking devices provided by other sections, including at elevator controls and cabinets.
    - a. When provisions for lock cylinders are referenced elsewhere in the Project Manual to this Section, provide compatible type of lock cylinder, keyed to building keying system, unless otherwise indicated.
- G. Products:
  - 1. Rim/mortise.

## 2.09 MORTISE LOCKS

- A. Manufacturers:
  - 1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 2. Sargent, Assa Abloy Group.
  - 3. Schlage, Allegion Group.
- B. Properties:
  - 1. Mechanical Locks: Manufacturer's standard.
    - a. Fitting modified ANSI A115.1 door preparation.
    - b. Door Thickness Coordination Fitting 1-3/4 inch (44 mm) to 2-1/4 inch (57 mm) thick doors.
    - c. Latch: Solid, one-piece, anti-friction, self-lubricating stainless steel.
      - 1) Latchbolt Throw: 3/4 inch (19 mm), minimum.
    - d. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
    - e. Backset: 2-3/4 inch (70 mm).

- f. Lever Trim:
  - 1) Functionality: Allow the lever handle to move up to 45 degrees from horizontal position prior to engaging the latchbolt assembly.
  - 2) Strength: Locksets outside locked lever designed to withstand minimum 1,400 inch- lbs (158.2 Nm) of torque. In excess of that, a replaceable part will shear. Key from outside and/or inside lever will still operate lockset.
  - 3) Spindle: Designed to prevent forced entry from attacking of lever.
  - 4) Independent spring mechanism for each lever.
    - (a) Trim to be self-aligning and thru-bolted.
  - 5) Handles: Made of forged or cast brass, bronze, or stainless steel construction. Levers that contain a hollow cavity are not acceptable.
  - 6) Levers to operate a roller bearing spindle hub mechanism.
- C. Finishes: See Door Hardware Schedule.
  - 1. Core Faces: Match finish of lockset.
- D. Grades:
  - 1. Comply with BHMA A156.13, Grade 1.
- E. Options:
  - 1. Provide locksets made in a manufacturing facility to compliant with ISO 9001-Quality Management and ISO 14001-Environmental Management.
- F. Products: Mortise locks, including standard types. 1. 40H.

## 2.10 AUXILIARY LOCKS (DEADLOCKS)

- A. Manufacturers:
  - 1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  - 2. Sargent, Assa Abloy Group.
  - 3. Schlage, Allegion Group.
- B. Properties:
  - 1. Backset: 2-3/4 inch (70 mm), unless otherwise indicated.
  - 2. Strike: Appropriate for door frame.
  - 3. Cylindrical Deadbolt: Manufacturer's standard, adjustable to accommodate range of door thicknesses indicated.
    - a. Door Thickness Fit: 1-3/8 inches (35 mm) to 3 inches (76 mm) thick doors.
    - b. Bolt Throw: 1 inch (25.4 mm) hardened steel.
    - c. UL listed for up to 3 hours.
- C. Grades:
  - 1. Cylindrical Deadbolts: Tested and approved by BHMA A156.36, Operational Grade 1.
- D. Products:
  - 1. 82/83T (Cylindrical, Grade 1).

## 2.11 NARROW STILE DEADLATCHES

- A. Manufacturers:
  - 1. Adams Rite, Assa Abloy Group.
  - 2. Schlage or Falcon, Allegion Group
- B. Properties:



1. Door Thickness Fit: 1-3/8 inch (35 mm) to 2-1/4 inch (57 mm) thick doors.
2. Cases:
  - a. Material: Steel with corrosion-resistant plating.
  - b. Depth: Varies, commensurate with backset dimension.
3. Backset: 1-1/8 inch (28.6 mm), unless otherwise noted.
4. Latch: Single piece tail-piece construction.
5. Auxiliary Deadlatch: One piece stainless steel, permanently lubricated.
6. Cylinders: Provide mortise cylinders.
7. Faceplates: Manufacturer's standard for lock selected and door edge condition.
8. Trim: See Door Hardware Schedule.

## 2.12 DOOR PULLS AND PUSH PLATES

- A. Manufacturers:
  1. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
  2. Hager
- B. Properties:
  1. Pull Type: Straight with additional piece to allow opening the door without gripping the handle.
  2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
    - a. Edges: Beveled, unless otherwise indicated.
- C. Grades: Comply with BHMA A156.6.
- D. Material: Stainless steel, unless otherwise indicated.
- E. Products:
  1. Push-Pull Plates.

## 2.13 CLOSERS

- A. Manufacturers:
  1. BEST, dormakaba Group [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  2. LCN, Allegion Group.
- B. Properties:
  1. Surface Mounted Closers: Manufacturer's standard.
    - a. Construction: Single piece casted cast iron housing.
    - b. Maximum Projection from Face of Door: 2-7/16 inches (62 mm).
    - c. Mechanism: Separate, tamper-resistant, retention ring, self-regulating adjusting valves for closing and latching speeds, backcheck, advanced variable backcheck and optional delayed action feature.
      - 1) All valve adjustment socket screw drives must be slotted hex not requiring special tools for maintenance or adjustments.
      - 2) Spring adjustment screw must be hex key.
      - 3) All valves must have mechanism to prevent oil leaks from over adjustment.
      - 4) All closer adjustments must be front facing and adjustable without removing closer from installed surface.
      - 5) Advanced Variable Backcheck: Backcheck positioning adjustment (POS)
        - (a) Selectable adjustment to facilitate degree of backcheck engagement point:
          - (1) Parallel arm mount: 50 degrees.

- (2) Regular arm and top jamb mount: Between 50 and 80 degrees.
    - (b) Intensity of backcheck shall be fully adjustable with tamper resistant non-critical valve screw.
  - 6) Spring Size:
    - (a) Adjustable spring sizes 1-6 with +50% power increase capability.
    - (b) Spring size indicator shall be easy to read, located front facing on the housing and adjustable without removal of housing from the installed surface.
  - d. Hydraulic: All-weather fluid.
  - e. Arm Assembly:
    - 1) Construction: Stamped arms and forged hub.
    - 2) Material: Steel.
    - 3) Degree of Swing:
      - (a) Parallel arm NHO mounting shall not limit opening angle and permit 180-degree door swing.
      - (b) Regular arm NHO mounting shall not limit opening angle and permit 120-degree door swing.
      - (c) Consult factory for non-standard templating.
    - 4) Include hold-open, integral stop, or spring-loaded stop feature, as specified in Door Hardware Schedule.
    - 5) Where obstructions limit opening angle and wall or floor stops are prohibited, provide "IS" or "S-IS" arms.
  - f. Covers:
    - 1) Type:
      - (a) Full. (standard)
    - 2) Material:
      - (a) Plastic. (standard)
    - 3) Finish:
      - (a) Painted. (standard)
    - 4) Attachment: Two-point flange mounting, dual-clamp friction fit closer cover.
- C. Grades:
  - 1. Closers: Comply with BHMA A156.4, Grade 1.
    - a. Underwriters Laboratories Compliance:
      - 1) Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
        - (a) CAN/ULC S-133 - Standard Method Of Tests For Door Closers Intended For Use With Swinging Doors.
    - b. Testing Standards Compliance: Meeting requirements of UL 10C for positive pressure.
- D. Code Compliance: As required by authorities having jurisdiction in the State in which the Project is located.
- E. Options:
  - 1. Delayed action, adjustable with an independent valve.
- F. Installation:
  - 1. Mounting: Includes surface mounted installations.
  - 2. Mount closers on non-public side of door and stair side of stair doors unless otherwise noted in hardware sets.
  - 3. At out swinging exterior doors, mount closer on interior side of door.
  - 4. Provide adapter plates, shim spacers, and blade stop spacers as required by frame and door conditions.
  - 5. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.

- G. Products:
  - 1. Surface Mounted:
    - a. EHD9000

## 2.14 SWINGING DOOR OPERATORS

- A. Manufacturers:
  - 1. Record
  - 2. dormakaba; dormakaba Group: [www.dormakaba.com/us-en/#sle](http://www.dormakaba.com/us-en/#sle).
  - 3. Stanley Access Technologies
- B. Properties:
  - 1. Where automatic operators are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by the manufacturer of the automatic operator for each individual leaf. Control both doors with actuators simultaneously at pairs. Locate actuators, key switches, and other controls as directed by Architect.
  - 2. Power-Assist Low Energy Operators:
    - a. Construction: Manufacturer's standard units with full covers.
    - b. Function Adjustability: Selectable low-energy or power-assist applications. Low-energy function to cycle the door open as programmed. Power-assist function for decreased opening force when manually operated. Operator to have a programmable push-and-go functionality.
    - c. Auxiliary Power Supply: 24VDC, 1.5A and form C relay contact for controlling fail safe/secure locking devices 50VAC or DC at 1A max.
    - d. Programmable Operation: Include sweep speed, latch speed, and backcheck cushioning.
    - e. Power-Open Functions: Include delay time, opening time, opening force, and opening angle.
      - 1) Angle and door width selector.
      - 2) Power boost feature.
    - f. On-board cycle counter.
    - g. Selectable jumper to accommodate push or pull side applications.
    - h. On/off strike delay when the operator must delay while a locking device releases.
    - i. Selectable on/off obstacle detection on closing.
  - 3. Actuators:
    - a. Hard-Wired Units: Wall-mounted and tamper-resistant.
      - 1) Normally open switch.
      - 2) Construction: Stainless-steel face plates, with heavy duty injection molded black ABS mounting boxes.
      - 3) Face Plate: Include manufacturer's standard international accessibility symbol and text "Press to Open".
- C. Grades:
  - 1. Comply with BHMA A156.19.
  - 2. Underwriters Laboratories Compliance:
    - a. Product Listing: UL (DIR) and ULC for use on fire-resistance-rated doors.
    - b. United States: UL 325.
- D. Types:
  - 1. Power-Assist Low-Energy Operators:
- E. Options: As applicable to each item specified.
  - 1. Delayed action, adjustable with an independent valve.
  - 2. Advanced backcheck.

3. Heavy-duty arms and knuckles/elbows.
4. Adjustable, for force or angle of opening hold open.
5. Cushion limit stay.

F. Installation:

1. Where automatic operators are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by the manufacturer of the automatic operator for each individual leaf. Configure actuators to control both doors simultaneously at pairs. Locate the actuators, key switches, and other controls as directed by Architect.
2. Operator Actuators: Include required back boxes, mounting rings, accessories as needed for fixed unit installation.

G. Products:

1. 8100 Series.

## 2.15 PROTECTION PLATES

A. Manufacturers:

1. Ives, Allegion Group.
2. Rockwood, Assa Abloy Group.
3. Hager

B. Properties:

1. Plates:
  - a. Armor Plates: Provide on bottom half of push side of doors that require protection from objects moving through openings that may damage door surface. Include integral edge guard at locations indicated in the hardware schedule.
  - b. Kick Plates: Provide along bottom edge of push side of every wood door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
  - c. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.
  - d. Edges: Beveled, on four (4) unless otherwise indicated.

C. Grades: Comply with BHMA A156.6.

D. Material: As indicated for each item by BHMA material and finish designation.

1. Metal Properties: Stainless steel.

E. Installation:

1. Fasteners: Countersunk screw fasteners.

## 2.16 STOPS AND HOLDERS

A. Manufacturers:

1. Ives, Allegion Group.
2. Rockwood, Assa Abloy Group.
3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
4. Hager

B. General: Provide overhead stop/holder when wall or floor stop is not feasible.

C. Grades:

1. Door Holders, Wall Bumpers, and Floor Stops: Comply with BHMA A156.16 and Resilient Material Retention Test as described in this standard.

- D. Material: Base metal as indicated for each item by BHMA material and finish designation.
- E. Types:
  - 1. Wall Bumpers: Bumper, concave, wall stop.
- F. Installation:
  - 1. Non-Masonry Walls: Confirm adequate wall reinforcement has been installed to allow lasting installation of wall bumpers.
- G. Products:
  - 1. Wall Bumpers.

## 2.17 ELECTROMAGNETIC DOOR HOLDERS

- A. Manufacturers:
  - 1. dormakaba; dormakaba Group: [www.dormakaba.com/us-en/#sle](http://www.dormakaba.com/us-en/#sle).
  - 2. Norton-Rixson – Assa Abloy Group
- B. Properties:
  - 1. Holding Force, Standard Duty: 40 lbs-force (177 N), minimum.
  - 2. Power Loss Status: Fail safe; door released to close.
  - 3. Life Safety Interface: With fire detectors, fire-alarm system, and smoke detectors for fire-resistance-rated door assemblies.
- C. Grades: Comply with BHMA A156.15.
- D. Types: Wall mounted, single unit, standard duty, with strike plate attached to door.
- E. Options: As applicable to each item specified.
  - 1. Voltage: 12 VDC.
- F. Products:
  - 1. EM Series.

## 2.18 THRESHOLDS

- A. Manufacturers:
  - 1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 2. Pemko, Assa Abloy Group.
  - 3. Zero, Allegion Group.
- B. Properties:
  - 1. Threshold Surface: Fluted horizontal grooves across full width.
- C. Grades: Thresholds: Comply with BHMA A156.21.
- D. Types: As applicable to project conditions. Verify project conditions to ensure specified thresholds will function as intended. Provide barrier-free type at every location where specified.
  - 1. Bumper Seal Thresholds with Gasket: Use silicone gaskets.

## 2.19 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
  - 1. National Guard Products, Inc: [www.ngpinc.com/#sle](http://www.ngpinc.com/#sle).
  - 2. Pemko, Assa Abloy Group.
  - 3. Zero, Allegion Group.
- B. Properties:
  - 1. Adhesive-Backed Perimeter Gasketing: Silicone gasket material applied to frame with self-adhesive.

2. Rigid, Housed, Perimeter Gasketing: Sponge silicone gasket material held in place by aluminum housing; fastened to frame stop with screws.
  3. Door Sweeps: Silicone gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.
- C. Grades: Comply with BHMA A156.22.

## 2.20 MISCELLANEOUS ITEMS

- A. Manufacturers:
1. Ives, Allegion Group.
  2. Rockwood, Assa Abloy Group.
  3. Trimco: [www.trimcohardware.com/#sle](http://www.trimcohardware.com/#sle).
- B. Properties:
1. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
    - a. Single Door: Provide three on strike jamb of frame.
    - b. Pair of Doors: Provide two on head of frame, one for each door at latch side.
    - c. Material: Rubber, gray color.
- C. Products:
1. Silencers.

## 2.21 ELECTRIFIED HARDWARE

- A. Manufacturers:
1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  2. dormakaba; dormakaba Group: [www.dormakaba.com/us-en/#sle](http://www.dormakaba.com/us-en/#sle).
  3. RCI; dormakaba Group: [www.dormakaba.com/us-en/#sle](http://www.dormakaba.com/us-en/#sle).
  4. Sargent, Assa Abloy Group.
  5. Schlage, Allegion Group.
  6. Von Duprin, Allegion Group.
- B. Properties:
1. Door Position Switches: Recessed devices with magnetic contacts.
    - a. Power Requirement: 50mA Max, 100 VDC.
    - b. SPDT configuration.
  2. Power Supply Units: Manufacturer's standard.
    - a. Enclosures: Lockable NEMA Type 1, with hinged cover and knockouts.
    - b. Emergency Release Terminals: Designed to release devices upon activation of fire alarm system.
    - c. Auxiliary contacts for remote signaling.
    - d. User-selectable time delay from 0 to 4 minutes.
    - e. Fire Alarm System Interface: Standard.
      - 1) Fire alarm terminal with green LED indicating power is available.
    - f. Output Distribution Board with indicator LEDs.
    - g. On/Off LED power indicator.
  3. Power Transfers: Manufacturer's standard.
    - a. Mortised Type with Wires & Connectors:
      - 1) Listed by UL and ULC.
      - 2) Stainless steel housing and spring conduit.

- 3) Wire Harness: Pre-installed, twelve wire, equipped with ten (10) 24 gauge wires and two 18 gauge wires.
  - 4) Accommodate 180 degree door swing.
  - 5) Quick-Connect Plugs: Pre-installed.
4. Wire Harnesses: Of sufficient length, with quick connectors.
    - a. Wire Harness End Connection to Power Supply or Junction Box: One end with bare leads.
- C. Products:
1. Door Position Switches:
    - a. 9540 Recessed Magnetic Contact/Door Position Switch.
  2. Power Transfers:
    - a. EPT-12C.
  3. Wire Harnesses:
    - a. BEST wire harnesses.

## 2.22 KEYS AND CORES

- A. Manufacturers:
1. BEST, dormakaba Group: [www.bestaccess.com/#sle](http://www.bestaccess.com/#sle).
  2. Substitutions: Not permitted.
- B. Properties: Complying with guidelines of BHMA A156.28.
1. Provide small format interchangeable core.
  2. Provide Patented CORMAX keys and cores.
  3. Provide keying information in compliance with DHI (KSN) standards.
  4. Keying Schedule: Arrange for a keying meeting, with Architect, Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying complies with project requirements.
  5. Keying: Master keyed. Key to Owner's existing key system.
  6. Include construction keying and control keying with removable core cylinders.
  7. Supply keys in following quantities:
    - a. Master Keys: 4 each.
    - b. Construction Master Keys: 6 each.
    - c. Construction Keys: 15 each.
    - d. Construction Control Keys: 2 each.
  8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
  9. Deliver keys with identifying tags to Owner by security shipment direct from manufacturer.
  10. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."
  11. Include installation of permanent cores and return construction cores to hardware supplier. Construction cores and keys to remain property of hardware supplier.
- C. Products:
1. Patented:
    - a. CORMAX.

## 2.23 FINISHES

- A. Finishes: Identified in Hardware Sets.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.
- B. Correct all defects prior to proceeding with installation.
- C. Verify that electric power is available to power operated devices and of correct characteristics.

### 3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware using the manufacturer's fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.
- C. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- D. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- E. Use templates provided by hardware item manufacturer.
- F. Do not install surface mounted items until application of finishes to substrate are fully completed.
- G. Wash down masonry walls and complete painting or staining of doors and frames.
- H. Complete finish flooring prior to installation of thresholds.
- I. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
- J. Include in installation for existing doors and frames any necessary field modification and field preparation of doors and frames for new hardware. Provide necessary fillers, reinforcements, and fasteners for mounting new hardware and to cover existing door and frame preparations.

### 3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 014000 - Quality Requirements.

### 3.04 ADJUSTING

- A. Adjust work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

### 3.05 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation activities.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

### 3.06 PROTECTION



- A. Protect finished Work under provisions of Section 017000 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

### 3.07 HARDWARE SCHEDULE

#### Manufacturer List

| Code: | Name:                         |
|-------|-------------------------------|
| AD    | Adams Rite                    |
| BE    | BEST Access Systems           |
| BY    | By Related Section or others. |
| DM    | Dorma Door Controls           |
| NA    | National Guard                |
| PR    | BEST Precision Exit Devices   |
| PX    | ePlex/Powerplate              |
| RC    | RCI                           |
| RECO  | Record                        |
| ST    | BEST Hinges and Sliding       |
| TR    | Trimco                        |

#### Option List

| Code:    | Description:                   |
|----------|--------------------------------|
| 1 1/8"BS | 1 1/8" Backset                 |
| B4E      | Beveled 4 Edges                |
| C        | Quick Connect Wiring Option    |
| CORMAX   | Cormax Patented Keying         |
| CSK      | Counter Sinking                |
| EPT Prep | EPT Prep                       |
| FL       | Fire Exit Hardware             |
| MLR      | Motorized Latch Retraction     |
| TS       | Touchbar Monitoring Switch     |
| VIB      | Double Vision Indicator Option |

#### Finish List

| Code: | Description:                      |
|-------|-----------------------------------|
| 130   | RiteCoat Painted - Satin Aluminum |
| 26D   | Satin Chrome                      |
| 32D   | Satin Stainless Steel             |
| 626   | Satin Chromium Plated             |
| 628   | Satin Aluminum, Clear Anodized    |
| 630   | Satin Stainless Steel             |
| 689   | Aluminum Painted                  |
| AL    | Aluminum                          |
| BLACK | Black                             |
| CL    | Clear                             |
| GREY  | Grey                              |

#### Hardware Sets

Set #1 - Ext. Access Control Pr. w/ Auto Operator

Doors: 101B, 118

|   |                  |                 |     |    |
|---|------------------|-----------------|-----|----|
| 1 | Continuous Hinge | 655 UL EPT Prep | 32D | ST |
|---|------------------|-----------------|-----|----|

|   |                   |                                    |       |    |
|---|-------------------|------------------------------------|-------|----|
| 1 | Continuous Hinge  | 655 UL                             | 32D   | ST |
| 1 | Removable Mullion | KR822                              | 689   | PR |
| 1 | Exit Device       | C MLR TS 2403 X 2903A              | 630   | PR |
| 1 | Exit Device       | C TS 2402 X 2902A                  | 630   | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 1 | Operator          | 8100 Series PUSH ARM               | CL    | RE |
| 1 | Closer w/ Stop    | EHD9016 DS90                       | 689   | BE |
| 2 | Push Plate        | 940HP-MO                           | 32D   | RC |
| 1 | Power Transfer    | EPT-12C                            | 630   | PR |
| 2 | Position Switch   | 9540                               | BLACK | RC |
| 1 | Harness           | WH-192                             |       | ST |
| 1 | Harness           | WH-6E                              |       | ST |
| 1 | Harness           | WH-12                              |       | ST |
| 1 | Card Reader       | By Access Control Contractor       |       | BY |
| 1 | Power Supply      | By Access Control Contractor       |       | BY |
| 1 | Mullion Seal      | 5100N                              |       | NA |
| 1 | Seals             | By Frame Mfr.                      |       | BY |
| 2 | Door Sweep        | 200 S                              |       | NA |
| 1 | Threshold         | 896 S                              | AL    | NA |

Set #2 - Ext. Access Control Pr.  
Doors: 112

|   |                   |                                    |       |    |
|---|-------------------|------------------------------------|-------|----|
| 1 | Continuous Hinge  | 655 UL EPT Prep                    | 32D   | ST |
| 1 | Continuous Hinge  | 655 UL                             | 32D   | ST |
| 1 | Removable Mullion | KR822                              | 689   | PR |
| 1 | Exit Device       | C MLR TS 2403 X 2903A              | 630   | PR |
| 1 | Exit Device       | C TS 2402 X 2902A                  | 630   | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 2 | Closer w/ Stop    | EHD9016 DS90                       | 689   | BE |
| 1 | Power Transfer    | EPT-12C                            | 630   | PR |
| 2 | Position Switch   | 9540                               | BLACK | RC |
| 1 | Harness           | WH-192                             |       | ST |
| 1 | Harness           | WH-6E                              |       | ST |
| 1 | Harness           | WH-12                              |       | ST |
| 1 | Card Reader       | By Access Control Contractor       |       | BY |
| 1 | Power Supply      | By Access Control Contractor       |       | BY |
| 1 | Mullion Seal      | 5100N                              |       | NA |
| 1 | Seals             | By Frame Mfr.                      |       | BY |
| 2 | Door Sweep        | 200 S                              |       | NA |
| 1 | Threshold         | 896 S                              | AL    | NA |

Set #2.1 - Ext. Pr.  
Doors: 101A

|   |                   |                                    |       |    |
|---|-------------------|------------------------------------|-------|----|
| 2 | Continuous Hinge  | 655 UL                             | 32D   | ST |
| 1 | Removable Mullion | KR822                              | 689   | PR |
| 1 | Exit Device       | C TS 2403 X 2903A                  | 630   | PR |
| 1 | Exit Device       | C TS 2402 X 2902A                  | 630   | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 2 | Closer w/ Stop    | EHD9016 DS90                       | 689   | BE |
| 2 | Position Switch   | 9540                               | BLACK | RC |
| 1 | Mullion Seal      | 5100N                              |       | NA |

|   |            |               |    |    |
|---|------------|---------------|----|----|
| 1 | Seals      | By Frame Mfr. |    | BY |
| 2 | Door Sweep | 200 S         |    | NA |
| 1 | Threshold  | 896 S         | AL | NA |

Set #3 - Balcony

Doors: 216, 302

|   |                  |                                   |       |    |
|---|------------------|-----------------------------------|-------|----|
| 1 | Continuous Hinge | 655 UL                            | 32D   | ST |
| 1 | Deadlock         | MS1850S 1 1/8"BS                  | 628   | AD |
| 1 | Mortise Cylinder | 1E-74 PATD CORMAX PATENTED KEYING | 626   | BE |
| 1 | Push Bar         | 1741                              | 630   | TR |
| 1 | Closer           | EHD9016 AF90P                     | 689   | BE |
| 1 | Wall Bumper      | 1270CV                            | 626   | TR |
| 1 | Position Switch  | 9540                              | BLACK | RC |
| 1 | Deadlock Lever   | 4550-01                           | 130   | AD |
| 1 | Seals            | By Frame Mfr.                     |       | BY |
| 1 | Door Sweep       | 200 S                             |       | NA |
| 1 | Threshold        | 896 S                             | AL    | NA |

Set #4 - Ext. Mech Pr.

Doors: 124

|   |                     |                                       |     |    |
|---|---------------------|---------------------------------------|-----|----|
| 2 | Continuous Hinge    | 655 UL                                | 32D | ST |
| 1 | Manual Flushbolt    | 3917-12                               | 626 | TR |
| 1 | Manual Flushbolt    | 3917-12ET                             | 626 | TR |
| 1 | Storeroom Lockset   | 45H-7D15H PATD CORMAX PATENTED KEYING | 626 | BE |
| 2 | Closer w/ Stop/H.O. | EHD9016 DST90                         | 689 | BE |
| 2 | Armor Plate w/ Edge | WA-A 34" x 1" LDW B4E CSK             | 630 | TR |
| 1 | Dust Proof Strike   | 3910                                  | 626 | TR |
| 1 | Astragal            | 139 SP                                |     | NA |
| 1 | Gasketing           | 110 SA                                |     | NA |
| 1 | Drip Cap            | 16 A - 4" ODW                         |     | NA |
| 2 | Door Sweep          | 200 S                                 |     | NA |
| 1 | Threshold           | 896 S                                 | AL  | NA |

Set #5 - Access Control - Inswing

Doors: 221, 310A, 341, 342, 343, 344, 345, 347, 348, 349, 350, 351, 352, 353, 354

|   |                  |                                   |       |    |
|---|------------------|-----------------------------------|-------|----|
| 1 | Continuous Hinge | 655 UL                            | 32D   | ST |
| 1 | Deadlatch        | 4510 1 1/8"BS                     | 628   | AD |
| 1 | Mortise Cylinder | 1E-74 PATD CORMAX PATENTED KEYING | 626   | BE |
| 1 | Electric Strike  | F1119-08                          | 32D   | RC |
| 1 | Push Bar         | 1741                              | 630   | TR |
| 1 | Closer           | EHD9016 AF90P                     | 689   | BE |
| 1 | Wall Bumper      | 1270CV                            | 626   | TR |
| 1 | Position Switch  | 9540                              | BLACK | RC |
| 1 | Harness          | WH-192                            |       | ST |
| 1 | Harness          | WH-6E                             |       | ST |
| 1 | Card Reader      | By Access Control Contractor      |       | BY |
| 1 | Paddle Operator  | 4590-Hand as req'd-00             | 628   | AD |
| 1 | Power Supply     | By Access Control Contractor      |       | BY |
| 1 | Seals            | By Frame Mfr.                     |       | BY |

Set #6 - Access Control Pr.  
Doors: 219B

|   |                   |                                    |       |    |
|---|-------------------|------------------------------------|-------|----|
| 1 | Continuous Hinge  | 655 UL EPT Prep                    | 32D   | ST |
| 1 | Continuous Hinge  | 655 UL                             | 32D   | ST |
| 1 | Removable Mullion | KR822                              | 689   | PR |
| 1 | Exit Device       | C MLR TS 2403 X 2903A              | 630   | PR |
| 1 | Exit Device       | C TS 2402 X 2902A                  | 630   | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 2 | Closer w/ Stop    | EHD9016 DS90                       | 689   | BE |
| 1 | Power Transfer    | EPT-12C                            | 630   | PR |
| 2 | Position Switch   | 9540                               | BLACK | RC |
| 1 | Harness           | WH-192                             |       | ST |
| 1 | Harness           | WH-6E                              |       | ST |
| 1 | Harness           | WH-12                              |       | ST |
| 1 | Card Reader       | By Access Control Contractor       |       | BY |
| 1 | Power Supply      | By Access Control Contractor       |       | BY |
| 1 | Mullion Seal      | 5100N                              |       | NA |
| 1 | Seals             | By Frame Mfr.                      |       | BY |

Set #7 - Access Control Pr.  
Doors: 120A

|   |                   |                                    |       |    |
|---|-------------------|------------------------------------|-------|----|
| 1 | Continuous Hinge  | 655 UL EPT Prep                    | 32D   | ST |
| 1 | Continuous Hinge  | 655 UL                             | 32D   | ST |
| 1 | Removable Mullion | KR822                              | 689   | PR |
| 1 | Exit Device       | C MLR TS 2403 X 2903A              | 630   | PR |
| 1 | Exit Device       | C TS 2402 X 2902A                  | 630   | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 2 | Closer            | EHD9016 AF90P                      | 689   | BE |
| 2 | Wall Bumper       | 1270CV                             | 626   | TR |
| 1 | Power Transfer    | EPT-12C                            | 630   | PR |
| 2 | Position Switch   | 9540                               | BLACK | RC |
| 1 | Harness           | WH-192                             |       | ST |
| 1 | Harness           | WH-6E                              |       | ST |
| 1 | Harness           | WH-12                              |       | ST |
| 1 | Card Reader       | By Access Control Contractor       |       | BY |
| 1 | Power Supply      | By Access Control Contractor       |       | BY |
| 1 | Mullion Seal      | 5100N                              |       | NA |
| 1 | Seals             | By Frame Mfr.                      |       | BY |

Set #8 – Pr. w/ Panics  
Doors: 340

|   |              |                                    |     |    |
|---|--------------|------------------------------------|-----|----|
| 2 | Rim Cylinder | 12E-72 PATD CORMAX PATENTED KEYING | 626 | BE |
|---|--------------|------------------------------------|-----|----|

Note: Remainder of Hardware by Fire Door and Frame Supplier. Coordinate with Door Supplier on quantity and type of cylinders required.

Set #9 - Storefront Class/Office  
Doors: 220, 222, 223, 224, 225, 226, 227, 228, 229, 230

|   |                  |        |     |    |
|---|------------------|--------|-----|----|
| 1 | Continuous Hinge | 655 UL | 32D | ST |
|---|------------------|--------|-----|----|

|   |                  |                                   |     |    |
|---|------------------|-----------------------------------|-----|----|
| 1 | Deadlock         | MS1850S 1 1/8"BS                  | 628 | AD |
| 1 | Keypad Trim      | E3066BNL041                       | 626 | PX |
| 1 | Mortise Cylinder | 1E-74 PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Closer           | EHD9016 AF90P                     | 689 | BE |
| 1 | Wall Bumper      | 1270CV                            | 626 | TR |
| 1 | Deadlock Lever   | 4550-01                           | 130 | AD |
| 1 | Seals            | By Frame Mfr.                     |     | BY |

Set #10 - Stairwell  
Doors: 106, 204

|   |                   |                                    |     |    |
|---|-------------------|------------------------------------|-----|----|
| 8 | Butt Hinge        | FBB179 4.5" x 4.5"                 | 26D | ST |
| 1 | Removable Mullion | FLKR822                            | 689 | PR |
| 1 | Exit Device       | FL 2108 X 4908A                    | 630 | PR |
| 1 | Exit Device       | FL 2102 X 4902A                    | 630 | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626 | BE |
| 2 | Magnetic Holder   | EM 505-24120                       | 689 | DM |
| 2 | Closer            | EHD9016 AF90P                      | 689 | BE |
| 2 | Kick Plate        | K0050 8" x 2" LDW B4E CSK          | 630 | TR |
| 1 | Mullion Seal      | 5100N                              |     | NA |
| 1 | Gasketing         | 110 SA                             |     | NA |

Set #11 - Stairwell  
Doors: 301

|   |                   |                                    |     |    |
|---|-------------------|------------------------------------|-----|----|
| 6 | Butt Hinge        | FBB179 4.5" x 4.5"                 | 26D | ST |
| 1 | Removable Mullion | FLKR822                            | 689 | PR |
| 1 | Exit Device       | FL 2108 X 4908A                    | 630 | PR |
| 1 | Exit Device       | FL 2102 X 4902A                    | 630 | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626 | BE |
| 2 | Magnetic Holder   | EM 505-24120                       | 689 | DM |
| 2 | Closer            | EHD9016 AF90P                      | 689 | BE |
| 2 | Kick Plate        | K0050 8" x 2" LDW B4E CSK          | 630 | TR |
| 1 | Mullion Seal      | 5100N                              |     | NA |
| 1 | Gasketing         | 110 SA                             |     | NA |

Set #12 - Stairwell  
Doors: 119A

|   |              |                                    |     |    |
|---|--------------|------------------------------------|-----|----|
| 3 | Butt Hinge   | FBB179 4.5" x 4.5"                 | 26D | ST |
| 1 | Exit Device  | FL 2108 X 4908A                    | 630 | PR |
| 1 | Rim Cylinder | 12E-72 PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Closer       | EHD9016 AF90P                      | 689 | BE |
| 1 | Kick Plate   | K0050 8" x 2" LDW B4E CSK          | 630 | TR |
| 1 | Wall Bumper  | 1270CV                             | 626 | TR |
| 1 | Gasketing    | 110 SA                             |     | NA |

Set #13 - Stairwell  
Doors: 217, 327

|   |             |                  |     |    |
|---|-------------|------------------|-----|----|
| 3 | Butt Hinge  | FBB168 5" x 4.5" | 26D | ST |
| 1 | Exit Device | FL 2108 X 4908A  | 630 | PR |

|   |              |                                    |     |    |
|---|--------------|------------------------------------|-----|----|
| 1 | Rim Cylinder | 12E-72 PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Closer       | EHD9016 AF90P                      | 689 | BE |
| 1 | Kick Plate   | K0050 8" x 2" LDW B4E CSK          | 630 | TR |
| 1 | Wall Bumper  | 1270CV                             | 626 | TR |
| 1 | Gasketing    | 110 SA                             |     | NA |

Set #14 - Ext. Stairwell – Access Control

Doors: 119B

|   |                  |                                    |       |    |
|---|------------------|------------------------------------|-------|----|
| 1 | Continuous Hinge | 655 UL EPT Prep                    | 32D   | ST |
| 1 | Exit Device      | C MLR TS 2403 X 4903A              | 630   | PR |
| 1 | Rim Cylinder     | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 1 | Closer w/ Stop   | EHD9016 DS90                       | 689   | BE |
| 1 | Power Transfer   | EPT-12C                            | 630   | PR |
| 1 | Position Switch  | 9540                               | BLACK | RC |
| 1 | Harness          | WH-192                             |       | ST |
| 1 | Harness          | WH-6E                              |       | ST |
| 1 | Harness          | WH-12                              |       | ST |
| 1 | Card Reader      | By Access Control Contractor       |       | BY |
| 1 | Power Supply     | By Access Control Contractor       |       | BY |
| 1 | Kick Plate       | K0050 8" x 2" LDW B4E CSK          | 630   | TR |
| 1 | Gasketing        | 110 SA                             |       | NA |
| 1 | Drip Cap         | 16 A - 4" ODW                      |       | NA |
| 1 | Door Sweep       | 200 S                              |       | NA |
| 1 | Threshold        | 896 S                              | AL    | NA |

Set #15 - Elec Rm

Doors: 110, 208, 305

|   |                     |                                    |      |    |
|---|---------------------|------------------------------------|------|----|
| 3 | Butt Hinge          | FBB168 5" x 4.5"                   | 26D  | ST |
| 1 | Exit Device         | 2103 X 4903A                       | 630  | PR |
| 1 | Rim Cylinder        | 12E-72 PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer              | EHD9016 AF90P                      | 689  | BE |
| 1 | Armor Plate w/ Edge | WA – A 34" x 1" LDW B4E CSK        | 630  | TR |
| 1 | Wall Bumper         | 1270CV                             | 626  | TR |
| 1 | Gasketing           | 110 SA                             | GREY | TR |

Set #16 - Class w/ Panics

Doors: 115A, 115B, 117A, 117B, 126A, 126B, 213A, 213B, 215A, 215B, 218A, 218B, 333A, 333B, 334A, 334B, 335A, 335B, 336A, 336B

|   |              |                                    |      |    |
|---|--------------|------------------------------------|------|----|
| 3 | Butt Hinge   | FBB179 4.5" x 4.5"                 | 26D  | ST |
| 1 | Exit Device  | 2108 X 4908A                       | 630  | PR |
| 1 | Rim Cylinder | 12E-72 PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer       | EHD9016 AF90P                      | 689  | BE |
| 1 | Kick Plate   | K0050 8" x 2" LDW B4E CSK          | 630  | TR |
| 1 | Wall Bumper  | 1270CV                             | 626  | TR |
| 3 | Silencer     | 1229A                              | GREY | TR |

Set #17 - Access Control Doors:

219A

|   |            |                    |     |    |
|---|------------|--------------------|-----|----|
| 3 | Butt Hinge | FBB179 4.5" x 4.5" | 26D | ST |
|---|------------|--------------------|-----|----|

|   |                 |                                    |       |    |
|---|-----------------|------------------------------------|-------|----|
| 1 | Exit Device     | C MLR TS 2103 X 4903A              | 630   | PR |
| 1 | Rim Cylinder    | 12E-72 PATD CORMAX PATENTED KEYING | 626   | BE |
| 1 | Closer          | EHD9016 AF90P                      | 689   | BE |
| 1 | Kick Plate      | K0050 8" x 2" LDW B4E CSK          | 630   | TR |
| 1 | Wall Bumper     | 1270CV                             | 626   | TR |
| 1 | Power Transfer  | EPT-12C                            | 630   | PR |
| 1 | Position Switch | 9540                               | BLACK | RC |
| 1 | Harness         | WH-192                             |       | ST |
| 1 | Harness         | WH-6E                              |       | ST |
| 1 | Harness         | WH-12                              |       | ST |
| 1 | Card Reader     | By Access Control Contractor       |       | BY |
| 1 | Power Supply    | By Access Control Contractor       |       | BY |
| 3 | Silencer        | 1229A                              | GREY  | TR |

Set #18 - Access Control Pr.  
Doors: 121A

|   |                      |                                       |       |    |
|---|----------------------|---------------------------------------|-------|----|
| 6 | Butt Hinge           | FBB179 4.5" x 4.5"                    | 26D   | ST |
| 1 | Semi- Auto Flushbolt | 3820 x 3810                           | 626   | TR |
| 1 | Storeroom Lockset    | 45H-7D 15H PATD CORMAX PATENED KEYING | 626   | BE |
| 1 | Electric Strike      | F2164                                 | 32D   | RC |
| 2 | Closer w/ Stop/Hold  | EHD9016 DST90                         | 689   | BE |
| 2 | Armor Plate w/ Edge  | WA-A 34" x 1" LDW B4E CSK             | 630   | TR |
| 1 | Power Transfer       | EPT-12C                               | 630   | PR |
| 1 | Position Switch      | 9540                                  | BLACK | RC |
| 1 | Harness              | WH-192                                |       | ST |
| 1 | Harness              | WH-6E                                 |       | ST |
| 1 | Harness              | WH-38                                 |       | ST |
| 1 | Card Reader          | By Access Control Contractor          |       | BY |
| 1 | Power Supply         | By Access Control Contractor          |       | BY |
| 1 | Dust Proof Strike    | 3910                                  | 626   | TR |
| 1 | Mullion Seal         | 5100N                                 |       | NA |
| 2 | Silencer             | 1229A                                 | GREY  | TR |

Set #19 - Access Control Pr.  
Doors: 123

|   |                      |                                       |       |    |
|---|----------------------|---------------------------------------|-------|----|
| 6 | Butt Hinge           | FBB179 4.5" x 4.5"                    | 26D   | ST |
| 1 | Semi- Auto Flushbolt | 3820 x 3810                           | 626   | TR |
| 1 | Storeroom Lockset    | 45H-7D 15H PATD CORMAX PATENED KEYING | 626   | BE |
| 1 | Electric Strike      | F2164                                 | 32D   | RC |
| 2 | Closer w/ Stop/Hold  | EHD9016 DST90                         | 689   | BE |
| 2 | Armor Plate w/ Edge  | WA-A 34" x 1" LDW B4E CSK             | 630   | TR |
| 2 | Wall Bumper          | 1270CV                                | 626   | TR |
| 1 | Power Transfer       | EPT-12C                               | 630   | PR |
| 2 | Position Switch      | 9540                                  | BLACK | RC |
| 1 | Harness              | WH-192                                |       | ST |
| 1 | Harness              | WH-6E                                 |       | ST |
| 1 | Harness              | WH-38                                 |       | ST |
| 1 | Card Reader          | By Access Control Contractor          |       | BY |
| 1 | Power Supply         | By Access Control Contractor          |       | BY |
| 1 | Dust Proof Strike    | 3910                                  | 626   | TR |
| 1 | Mullion Seal         | 5100N                                 |       | NA |

|   |          |       |      |    |
|---|----------|-------|------|----|
| 2 | Silencer | 1229A | GREY | TR |
|---|----------|-------|------|----|

Set #20 - Access Control Pr  
Doors: 122, 125

|   |                      |                                       |       |    |
|---|----------------------|---------------------------------------|-------|----|
| 6 | Butt Hinge           | FBB168 4.5" x 4.5"                    | 26D   | ST |
| 1 | Semi- Auto Flushbolt | 3820 x 3810                           | 626   | TR |
| 1 | Storeroom Lockset    | 45H-7D 15H PATD CORMAX PATENED KEYING | 626   | BE |
| 1 | Electric Strike      | F2164                                 | 32D   | RC |
| 2 | Closer w/ Stop/Hold  | EHD9016 DST90                         |       |    |
| 2 | Armor Plate w/ Edge  | WA-A 34" x 1" LDW B4E CSK             | 630   | TR |
| 2 | Wall Bumper          | 1270CV                                | 626   | TR |
| 1 | Power Transfer       | EPT-12C                               | 630   | PR |
| 2 | Position Switch      | 9540                                  | BLACK | RC |
| 1 | Harness              | WH-192                                |       | ST |
| 1 | Harness              | WH-6E                                 |       | ST |
| 1 | Harness              | WH-38                                 |       | ST |
| 1 | Card Reader          | By Access Control Contractor          |       | BY |
| 1 | Power Supply         | By Access Control Contractor          |       | BY |
| 1 | Mullion Seal         | 5100N                                 |       | NA |
| 2 | Silencer             | 1229A                                 | GREY  | TR |

Set #21 - Classroom Exit Only  
Doors: 120B

|   |             |                           |      |    |
|---|-------------|---------------------------|------|----|
| 3 | Butt Hinge  | FBB179 4.5" x 4.5"        | 26D  | ST |
| 1 | Exit Device | 2101                      | 630  | PR |
| 1 | Closer      | EHD9016 AF90P             | 689  | BE |
| 1 | Kick Plate  | K0050 8" x 2" LDW B4E CSK | 630  | TR |
| 1 | Wall Bumper | 1270CV                    | 626  | TR |
| 3 | Silencer    | 1229A                     | GREY | TR |

Set #22 - Corridor  
Doors: 109, 207A

|   |                   |                                    |      |    |
|---|-------------------|------------------------------------|------|----|
| 8 | Butt Hinge        | FBB168 4.5" x 4.5"                 | 26D  | ST |
| 1 | Removable Mullion | KR822                              | 689  | PR |
| 1 | Exit Device       | 2108 X 4908A                       | 630  | PR |
| 1 | Exit Device       | 2102 X 4902A                       | 630  | PR |
| 2 | Rim Cylinder      | 12E-72 PATD CORMAX PATENTED KEYING | 626  | BE |
| 2 | Magnetic Holder   | EM 505-24120                       | 689  | DM |
| 2 | Closer            | EHD9016 AF90P                      | 689  | BE |
| 2 | Kick Plate        | K0050 8" x 2" LDW B4E CSK          | 630  | TR |
| 1 | Mullion Seal      | 5100N                              |      | NA |
| 2 | Silencer          | 1229A                              | GREY | TR |

Set #23 - Access Control  
Doors: 310B, 328A, 329A, 329B, 331A, 339

|   |                   |                                       |     |    |
|---|-------------------|---------------------------------------|-----|----|
| 3 | Butt Hinge        | FBB179 4.5" x 4.5"                    | 26D | ST |
| 1 | Storeroom Lockset | 45H-7D15H PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Electric Strike   | F2164                                 | 32D | RC |
| 1 | Closer            | EHD9016 AF90P                         | 689 | BE |



|   |                 |                              |       |    |
|---|-----------------|------------------------------|-------|----|
| 1 | Kick Plate      | K0050 8" x 2" LDW B4E CSK    | 630   | TR |
| 1 | Wall Bumper     | 1270CV                       | 626   | TR |
| 1 | Position Switch | 9540                         | BLACK | RC |
| 1 | Harness         | WH-192                       |       | ST |
| 1 | Harness         | WH-6E                        |       | ST |
| 1 | Card Reader     | By Access Control Contractor |       | BY |
| 1 | Power Supply    | By Access Control Contractor |       | BY |
| 3 | Silencer        | 1229A                        | GREY  | TR |

Set #24 - Classroom

Doors: 116, 214

|   |                   |                                       |      |    |
|---|-------------------|---------------------------------------|------|----|
| 3 | Butt Hinge        | FBF179 4.5" x 4.5"                    | 26D  | ST |
| 1 | Classroom Lockset | 45H-7R15H PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer            | EHD9016 AF90P                         | 689  | BE |
| 1 | Kick Plate        | K0050 8" x 2" LDW B4E CSK             | 630  | TR |
| 1 | Wall Bumper       | 1270CV                                | 626  | TR |
| 3 | Silencer          | 1229A                                 | GREY | TR |

Set #25 - Office

Doors: 324A

|   |                |                                    |      |    |
|---|----------------|------------------------------------|------|----|
| 3 | Butt Hinge     | FBF179 4.5" x 4.5"                 | 26D  | ST |
| 1 | Office Lockset | 45H-7AB15H PATD CORMAX PAT. KEYING | 626  | BE |
| 1 | Closer w/ Stop | EHD9016 DS90                       | 689  | BE |
| 1 | Kick Plate     | K0050 8" x 2" LDW B4E CSK          | 630  | TR |
| 3 | Silencer       | 1229A                              | GREY | TR |

Set #26 - Office

Doors: 328B

|   |                |                                    |      |    |
|---|----------------|------------------------------------|------|----|
| 3 | Butt Hinge     | FBF179 4.5" x 4.5"                 | 26D  | ST |
| 1 | Office Lockset | 45H-7AB15H PATD CORMAX PAT. KEYING | 626  | BE |
| 1 | Closer         | EHD9016 AF90P                      | 689  | BE |
| 1 | Kick Plate     | K0050 8" x 2" LDW B4E CSK          | 630  | TR |
| 1 | Wall Bumper    | 1270CV                             | 626  | TR |
| 3 | Silencer       | 1229A                              | GREY | TR |

Set #27 - Office

Doors: 314, 315, 316, 317, 318, 319, 320, 321, 323, 324B

|   |                |                                    |      |    |
|---|----------------|------------------------------------|------|----|
| 3 | Butt Hinge     | FBF179 4.5" x 4.5"                 | 26D  | ST |
| 1 | Office Lockset | 45H-7AB15H PATD CORMAX PAT. KEYING | 626  | BE |
| 1 | Wall Bumper    | 1270CV                             | 626  | TR |
| 3 | Silencer       | 1229A                              | GREY | TR |

Set #28 - Restroom

Doors: 107, 108, 205, 206, 303, 304

|   |                    |                                    |     |    |
|---|--------------------|------------------------------------|-----|----|
| 3 | Butt Hinge         | FBF179 4.5" x 4.5"                 | 26D | ST |
| 1 | Classroom Deadbolt | 8T3-7S PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Push/Pull Plate    | 1835-3                             | 630 | TR |
| 1 | Closer             | EHD9016 AF90P                      | 689 | BE |

|   |             |                           |      |    |
|---|-------------|---------------------------|------|----|
| 1 | Kick Plate  | K0050 8" x 2" LDW B4E CSK | 630  | TR |
| 1 | Mop Plate   | KM050 4" x 1" LDW B4E CSK | 630  | TR |
| 1 | Wall Bumper | 1270CV                    | 626  | TR |
| 3 | Silencer    | 1229A                     | GREY | TR |

Set #29 - Passage Set

Doors: 331B

|   |             |                           |      |    |
|---|-------------|---------------------------|------|----|
| 3 | Butt Hinge  | FBB179 4.5" x 4.5"        | 26D  | ST |
| 1 | Passage Set | 45H-0N15H                 | 626  | BE |
| 1 | Closer      | EHD9016 AF90P             | 689  | BE |
| 1 | Kick Plate  | K0050 8" x 2" LDW B4E CSK | 630  | TR |
| 1 | Wall Bumper | 1270CV                    | 626  | TR |
| 3 | Silencer    | 1229A                     | GREY | TR |

Set #30 - Individual Restroom

Doors: 325

|   |                |                           |      |    |
|---|----------------|---------------------------|------|----|
| 3 | Butt Hinge     | FBB179 4.5" x 4.5"        | 26D  | ST |
| 1 | Privacy Set    | 45H-0L15H                 | 626  | BE |
| 1 | Closer w/ Stop | EHD9016 DS90              | 689  | BE |
| 1 | Kick Plate     | K0050 8" x 2" LDW B4E CSK | 630  | TR |
| 1 | Mop Plate      | KM050 4" x 1" LDW B4E CSK | 630  | TR |
| 3 | Silencer       | 1229A                     | GRAY | TR |

Set #31 - Individual Restroom

Doors: 330, 332

|   |             |                           |      |    |
|---|-------------|---------------------------|------|----|
| 3 | Butt Hinge  | FBB179 4.5" x 4.5"        | 26D  | ST |
| 1 | Privacy Set | 45H-0L15H                 | 626  | BE |
| 1 | Closer      | EHD9016 AF90P             | 689  | BE |
| 1 | Kick Plate  | K0050 8" x 2" LDW B4E CSK | 630  | TR |
| 1 | Mop Plate   | KM050 4" x 1" LDW B4E CSK | 630  | TR |
| 1 | Wall Bumper | 1270CV                    | 626  | TR |
| 3 | Silencer    | 1229A                     | GREY | TR |

Set #32 - Custodial

Doors: 111, 209, 306

|   |                     |                                       |      |    |
|---|---------------------|---------------------------------------|------|----|
| 3 | Butt Hinge          | FBB179 4.5" x 4.5"                    | 26D  | ST |
| 1 | Storeroom Lockset   | 45H-7D15H PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer w/Stop       | EHD9016 DS90                          | 689  | BE |
| 1 | Armor Plate w/ Edge | WA-A 34" x 1" LDW B4E CSK             | 630  | TR |
| 3 | Silencer            | 1229A                                 | GREY | TR |

Set #33 - F/R Storage

Doors: 104

|   |                     |                                       |     |    |
|---|---------------------|---------------------------------------|-----|----|
| 3 | Butt Hinge          | FBB179 4.5" x 4.5"                    | 26D | ST |
| 1 | Storeroom Lockset   | 45H-7D15H PATD CORMAX PATENTED KEYING | 626 | BE |
| 1 | Closer w/ Stop      | EHD9016 DS90                          | 689 | BE |
| 1 | Armor Plate w/ Edge | WA-W 34" x 1" LDW B4E CSK UL Rated    | 630 | TR |
| 1 | Gasketing           | 110 SA                                |     | NA |

Set #34 - Data Doors:  
114, 212, 309

|   |                   |                                       |      |    |
|---|-------------------|---------------------------------------|------|----|
| 3 | Butt Hinge        | FBB179 4.5" x 4.5"                    | 26D  | ST |
| 1 | Storeroom Lockset | 45H-7D15H PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer            | EHD9016 AF90P                         | 689  | BE |
| 1 | Kick Plate        | K0050 8" x 2" LDW B4E CSK             | 630  | TR |
| 1 | Wall Bumper       | 1270CV                                | 626  | TR |
| 3 | Silencer          | 1229A                                 | GREY | TR |

Set #35 - Storage  
Doors: 313

|   |                   |                                       |      |    |
|---|-------------------|---------------------------------------|------|----|
| 3 | Butt Hinge        | FBB179 4.5" x 4.5"                    | 26D  | ST |
| 1 | Storeroom Lockset | 45H-7D15H PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Wall Bumper       | 1270CV                                | 626  | TR |
| 3 | Silencer          | 1229A                                 | GREY | TR |

Set #35.1 - Storage Doors:  
312A, 312B

|   |                   |                                       |      |    |
|---|-------------------|---------------------------------------|------|----|
| 3 | Butt Hinge        | FBB179 4.5" x 4.5"                    | 26D  | ST |
| 1 | Storeroom Lockset | 45H-7D15H PATD CORMAX PATENTED KEYING | 626  | BE |
| 1 | Closer            | EHD9016 AF90P                         | 689  | BE |
| 1 | Kickplate         | K0050 8" x 2" LDW B4E CSK             | 630  | TR |
| 1 | Wall Bumper       | 1270CV                                | 626  | TR |
| 3 | Silencer          | 1229A                                 | GREY | TR |

Set #36 - Overhead Door Doors:  
120C, 121B

|   |         |                   |  |    |
|---|---------|-------------------|--|----|
| 1 | Padlock | Provided by Owner |  | BY |
|---|---------|-------------------|--|----|

Set #37 – Exterior Access Panels  
Doors: EAP1 and EAP2

|   |                  |                                   |     |    |
|---|------------------|-----------------------------------|-----|----|
| 1 | Mortise Cylinder | 1E-74 PATD CORMAX PATENTED KEYING | 626 | BE |
|---|------------------|-----------------------------------|-----|----|

Note: Remainder of Hardware by Access Door Supplier. Verify quantity / type of cylinders required.

Set # 38 – Classroom  
Doors: 338

|   |             |  |      |    |
|---|-------------|--|------|----|
| 3 | Butt Hinges | FBB179 4.5" x 4.5"                     | 26D  | ST |
| 1 | Lockset     | 45H-71T15H PATD CORMAX PAT. KEYING VIB | 626  | BE |
| 1 | Closer      | EHD9016 AF90P                          | 689  | BE |
| 1 | Kickplate   | K0050 8" x 2" LDW B4E CSK              | 630  | TR |
| 1 | Wall Bumper | 1270CV                                 | 626  | TR |
| 3 | Silencer    | 1229A                                  | GREY | TR |

## Opening List

| Opening: | Hardware Set: |
|----------|---------------|
| 101A     | 2.1           |
| 101B     | 1             |
| 104      | 33            |
| 106      | 10            |
| 107      | 28            |
| 108      | 28            |
| 110      | 15            |
| 111      | 32            |
| 112      | 2             |
| 114      | 34            |
| 115A     | 16            |
| 115B     | 16            |
| 116      | 24            |
| 117A     | 16            |
| 117B     | 16            |
| 118      | 1             |
| 119A     | 12            |
| 119B     | 14            |
| 120A     | 7             |
| 120B     | 21            |
| 120C     | 36            |
| 121A     | 18            |
| 121B     | 36            |
| 122      | 20            |
| 123      | 19            |
| 124      | 4             |
| 125      | 20            |
| 126A     | 16            |
| 126B     | 16            |
| 204      | 10            |
| 205      | 28            |
| 206      | 28            |
| 207A     | 22            |
| 208      | 15            |
| 209      | 32            |
| 212      | 34            |
| 213A     | 16            |
| 213B     | 16            |
| 214      | 24            |
| 215A     | 16            |
| 215B     | 16            |
| 216      | 3             |
| 217      | 13            |
| 218A     | 16            |
| 218B     | 16            |
| 219A     | 17            |
| 219B     | 6             |
| 220      | 9             |
| 221      | 5             |
| 222      | 9             |

|      |      |
|------|------|
| 223  | 9    |
| 224  | 9    |
| 225  | 9    |
| 226  | 9    |
| 227  | 9    |
| 228  | 9    |
| 229  | 9    |
| 230  | 9    |
| 301  | 11   |
| 302  | 3    |
| 303  | 28   |
| 304  | 28   |
| 305  | 15   |
| 306  | 32   |
| 309  | 34   |
| 310A | 5    |
| 310B | 23   |
| 312A | 35.1 |
| 312B | 35.1 |
| 313  | 35   |
| 314  | 27   |
| 315  | 27   |
| 316  | 27   |
| 317  | 27   |
| 318  | 27   |
| 319  | 27   |
| 320  | 27   |
| 321  | 27   |
| 323  | 27   |
| 324A | 25   |
| 324B | 27   |
| 325  | 30   |
| 327  | 13   |
| 328A | 23   |
| 328B | 26   |
| 329A | 23   |
| 329B | 23   |
| 330  | 31   |
| 331A | 23   |
| 331B | 29   |
| 332  | 31   |
| 333A | 16   |
| 333B | 16   |
| 334A | 16   |
| 334B | 16   |
| 335A | 16   |
| 335B | 16   |
| 336A | 16   |
| 336B | 16   |
| 338  | 38   |
| 339  | 23   |
| 340  | 8    |
| 341  | 5    |
| 342  | 5    |
| 343  | 5    |

|     |    |   |
|-----|----|---|
| 344 |    | 5 |
| 345 |    | 5 |
| 347 |    | 5 |
| 348 | 5  |   |
| 349 | 5  |   |
| 350 | 5  |   |
| 351 | 5  |   |
| 352 | 5  |   |
| 353 | 5  |   |
| 354 | 5  |   |
| 109 | 22 |   |
| EAP | 37 |   |

END OF SECTION 08 71 00

## **SECTION 08 80 00 – GLAZING**

### **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. Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls, glass canopy structure.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 08 11 10 "Hollow Metal Doors and Frames" for Doors and/or Frames with glass glazing vision panels.
  - 2. Section 08 21 00 "Flush Wood Doors" for Doors with glass glazing vision panels.
  - 3. Section 08 41 13 "Aluminum Entrances and Storefronts" for aluminum storefront systems.
  - 4. Section 08 42 00 "Fire Rated Steel Framed Entrance Systems" for Fire Rated Glazed Exterior Entry Doors and Transoms with fire rated factory glazing.
  - 5. Section 08 44 31 "Glazed Aluminum Curtainwalls" for aluminum curtainwall systems.

#### **1.3 DEFINITIONS**

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

#### **1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review temporary protection requirements for glazing during and after installation.

#### **1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1. Tinted glass.
2. Coated glass.
3. Laminated glass.
4. Insulating glass.

- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturers of insulating-glass units with sputter-coated, low-E coatings.
- B. Product Certificates: For glass.
- C. Preconstruction adhesion and compatibility test report.
- D. Sample Warranties: For special warranties.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

#### 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
  2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
  5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid



hermetic seal ruptures due to altitude change.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

#### 1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
  - 1. Vitro Architectural Glass-PPG Industries, Inc.
  - 2. Viracon, Inc.
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  - 1. Obtain tinted glass from single source from single manufacturer.
  - 2. Obtain reflective-coated glass from single source from single manufacturer.

- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: As indicated on Drawings.
    - b. Basic Wind Speed: As indicated on the Drawings
    - c. Importance Factor: 1.0
    - d. Exposure Category: B.
  - 3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
  - 4. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
  - 5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
  - 6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
  - 2. For laminated-glass lites, properties are based on products of construction indicated.
  - 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
  - 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  - 2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
  - 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
  - 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.
  - 2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

## 2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
- C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
- D. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- E. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

## 2.5 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
  2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
  3. Interlayer Color: Clear unless otherwise indicated.
- B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with the following to comply with interlayer manufacturer's written instructions:
1. Polyvinyl butyral interlayer.
- 2.6 INSULATING GLASS
- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  2. Perimeter Spacer: Manufacturer's standard spacer material and construction.
- 2.7 GLAZING SEALANTS
- A. General:
1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- 2.8 GLAZING TAPES
- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that

exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make

them fit opening.

- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

### 3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type G4: interior openings below 36" and next to doors and in interior doors Unless noted otherwise: Clear annealed fully tempered float glass.
  - 1. Minimum Thickness: 1/4" mm.
  - 2. Safety glazing required.

### 3.9 LAMINATED GLASS SCHEDULE

- A. Glass Type G5: Clear Laminated Glass.
  - 1. Safety glazing required.
  - 2. Glass: Clear laminated glass with minimum thickness of 9/16".
    - a. Interlayer: Polyvinyl Butyral (PVB) interlayer conforming to ASTM D 1044
      - 1) Color: Clear
      - 2) Thickness: 0.090" (2.29 mm)
  - 3. Safety Glazing: Clear laminated glass shall comply with CPSC 16 CFR 1201 Category II or ANSI Z97.1.
- B. Glass Type G6 (Canopy Glazing): Clear Laminated Glass with Custom Frit
  - 1. Glass: Clear laminated glass with minimum thickness of 9/16"
    - a. Interlayer: Polyvinyl Butyral (PVB) interlayer conforming to ASTM D 1044
      - 1) Color: Clear
      - 2) Thickness: 0.090" (2.29 mm)
    - b. Frit: 1/8" line, 3/32" space (60% solid, 40% open).
      - 1) Frit Color: Custom



### 3.10 INSULATING GLASS SCHEDULE

- A. Glass Type G1: Double Glazed Clear Solar Control Insulating Glass Unit Solarban®70XL \* 6mm (2) | Air 1/2" (12.7mm) | 6mmClear
1. Conformance: ASTM E 2190
  2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass
    - a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
    - b. Glass Thickness: 6mm (1/4")
    - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
    - d. Coating: Solarban® 70XL on Surface # 2
    - e. Heat-Treatment: Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201
  3. Interspace Content: Air 1/2" (12.7mm)
  4. Indoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass
    - a. Conformance: ASTM C 1036, Type I, Class 1, Quality q3
    - b. Thickness: 6mm (1/4")
    - c. Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS
  5. Performance Requirements:
    - a. Visible Light Transmittance: 64 percent minimum.
    - b. Winter Nighttime U-Factor: 0.28 (Btu/hr\*ft<sup>2</sup>\*°F) maximum.
    - c. Summer daytime U-Factor: 0.26 (Btu/hr\*ft<sup>2</sup>\*°F) maximum.
    - d. Shading Coefficient: 0.32 maximum.
    - e. Solar Heat Gain Coefficient: 0.27 maximum.
    - f. Outdoor Visible Light Reflectance: 13 percent maximum.
- B. Glass Type G2: Double Glazed Clear Solar Control Laminated Spandrel Insulating Glass Unit Solarban® 70XL \* 6mm (2) | Air 1/2" (12.7mm) | 3mmClear\_090Gray6544PVB\_3mm Opacicoat Charcoal (6)Clear
1. Conformance: ASTM E 2190, ASTM C 1048, Condition B, Type I, Quality-Q3 and GANA 'Engineering Standards Manual' GANA 66-9-20 Specification for Heat-Strengthened or Fully Tempered Ceramic Enamelled Spandrel Glass for Use in Building Window/Curtain Walls and Other Architectural Applications.
  2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass
    - a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
    - b. Glass Thickness: 6mm (1/4")
    - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
    - d. Coating: Solarban® 70XL on Surface # 2
    - e. Heat-Treatment: Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201
  3. Interspace Content: Air 1/2" (12.7mm)
  4. Indoor Lite: Laminate
    - a. Conformance: ASTM C1172 and complying with testing requirements
    - b. Laminate Outboard Lite: Clear float glass as manufactured by Vitro Architectural Glass.

- 1) Conformance: ASTM C 1036, Type I, Class 1, Quality q3
  - 2) Thickness: 3mm (1/8")
  - 3) Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS
- c. Interlayer:
- 1) Type: PVB
  - 2) Thickness: 0.090" (2.29 mm)
  - 3) Color: Gray
- d. Laminate Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass
- 1) Conformance: ASTM C 1036, Type I, Class 1, Quality q3
  - 2) Thickness: 3mm (1/8")
  - 3) Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS
  - 4) Coating Type, Color, Number, % Coverage: Opaci-Coat, Charcoal, 100% Coverage.
  - 5) Spandrel Coating Surface: 6
- C. Glass Type G3 (Color Laminated): Double Glazed Clear Solar Control Laminated Spandrel Insulating Glass Unit Solarban® 70XL \* 6mm (2) | Air 1/2" (12.7mm) | 3mmClear\_060PVB\_Colored Film\_3mm Opacicoat Charcoal (6)Clear
1. Conformance: ASTM E 2190.
  2. Outdoor Lite: Clear Float Glass as manufactured by Vitro Architectural Glass
    - a. Conformance: ASTM C 1036, Type 1, Class 1, Quality q3.
    - b. Glass Thickness: 6mm (1/4")
    - c. Magnetic Sputter Vacuum Deposition Coating (MSVD): ASTM C 1376.
    - d. Coating: Solarban® 70XL on Surface # 2
  - e. Heat-Treatment: Tempered; ASTM C 1048, Kind FT; Safety Glazing meets ANSI Z97.1 and CPSC 16CFR-1201
  3. Interspace Content: Air 1/2" (12.7mm)
  4. Indoor Lite: Laminate
    - a. Conformance: ASTM C1172 and complying with testing requirements
    - b. Laminate Outboard Lite: Clear float glass as manufactured by Vitro Architectural Glass.
      - 1) Conformance: ASTM C 1036, Type I, Class 1, Quality q3
      - 2) Thickness: 3mm (1/8")
      - 3) Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS
    - c. Interlayer:
      - 1) Type: PVB
        - a) Thickness: 0.090" (2.29 mm)
        - b) Color: Clear
      - 2) Color Film: Color as selected by Architect from manufacturer's full range of available colors
        - a) Layers: Up to (4) layers to achieve desired color and color depth
    - d. Laminate Inboard Lite: Clear float glass as manufactured by Vitro Architectural Glass

- 1) Thickness: 3mm (1/8")
- 2) Heat-Treatment: Heat-strengthened, ASTM C 1048, Kind HS

END OF SECTION 08 80 00

## SECTION 09 25 30 - GYPSUM SHEATHING

### 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 gypsum sheathing attached to steel framing members of exterior walls.
- B. Related Sections include the following:
  - 1. Division 4 Section "Unit Masonry" for masonry-veneer anchors.
  - 2. Division 5 Section "Cold-Formed Metal Framing" for steel framing supporting gypsum sheathing on the exterior and gypsum wall board on the interior.
  - 3. Division 7 Section "Fluid Applied Membrane Air/Vapor Barriers" for Air/Vapor Barriers installed over gypsum sheathing.
  - 4. Division 7 Section "Joint Sealants" for sealants applied with gypsum sheathing.
  - 5. Division 9 Section "Gypsum Board Assemblies" for light gauge steel-framed assemblies with gypsum sheathing on the exterior and gypsum wallboard on the interior.

#### 1.3 DEFINITIONS

- A. Gypsum Board Construction Terminology Standard: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum sheathing board construction not defined in this Section or in other referenced standards.

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each gypsum sheathing product through one source from a single manufacturer.
- B. Fire-Resistance-Rated Assemblies: Where gypsum sheathing boards are part of fire-resistance-rated assemblies, provide assemblies as follows:
  - 1. Assemblies comply with requirements of fire-response-tested assemblies indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual"; or by design designations in UL's "Fire Resistance Directory" or in certification listings of another testing and inspecting agency

acceptable to authorities having jurisdiction.

2. Fire-resistance ratings were determined by fire-response testing assemblies according to ASTM E 119.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles, each bearing brand name and identification of manufacturer.
- B. Store materials protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, or other causes. Neatly stack gypsum sheathing board flat on leveled supports off the ground, under cover, and fully protected from weather.

## 1.7 SEQUENCING AND SCHEDULING

- A. Sequence installing sheathing with installing exterior cladding to comply with requirements indicated below:
  1. Do not leave exterior gypsum sheathing board exposed to weather for more than six (6) months without installing damp proofing membrane protection.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Glass-Mat Gypsum Sheathing Board:
    - a. Gold Bond; E<sup>2</sup> XP Extended Exposure Sheathing - Type X, Fireshield
    - b. Georgia-Pacific Corp. (Dens-Glass Gold Fireguard)
    - c. USG Corp.; United States Gypsum Co. (Securock Glass-Mat Sheathing) (Firecode X)

### 2.2 GYPSUM SHEATHING BOARD

- A. Glass-Mat Gypsum Sheathing Board with Water-Resistant Core: ASTM C 1177, with water-resistant material incorporated into the core and with water-repellent glass mat bonded to the core's face, back, and long edges.
  1. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
  2. Edge and End Configuration: Square.
  3. Size: 48 by 96 inches or 108 inches (1219 by 2743 mm).

### 2.3 ACCESSORY MATERIALS

- A. Fasteners: Steel bugle head galvanized or cadmium plated drill screws, in length recommended by sheathing manufacturer for thickness of sheathing board to be attached.

1. Provide steel drill screws complying with ASTM C 954 to attach sheathing to steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install gypsum sheathing to comply with GA-253 and manufacturer's written instructions.
- B. Cut boards at penetrations, edges, and other obstructions of the work; fit tightly against abutting construction, except provide a 3/8-inch (9-mm) setback where non-load-bearing construction abuts structural elements.
- C. Coordinate sheathing installation with flashing and joint sealant installation so these materials are installed in the sequence and manner that prevent exterior moisture from passing through completed exterior wall assembly.
- D. Apply fasteners so screw heads bear tightly against face of sheathing boards but do not cut into facing.
- E. Do not bridge building expansion joints with sheathing; cut and space edges to match spacing of structural support elements.
- F. Vertical Installation: Install 48-inch- (1219-mm-) wide gypsum sheathing boards vertically with vertical edges centered over flanges of steel studs. Abut ends and edges of each board with those of adjacent boards. Screw-attach boards at perimeter and within field of board to each steel stud as follows:
  1. Fasteners spaced approximately 8 inches o.c. and set back a minimum of 3/8 inch (9 mm) from edges and ends of boards. Fasten at approximately 8" o.c. at supports in field of sheathing board.

### 3.2 PROTECTION

- A. Protect gypsum sheathing that will be exposed to weather by installing membrane air barriers as specified as soon as practical but in no case more than six (6) months after sheathing is installed.

END OF SECTION 09 25 30

## **SECTION 09 25 50 - GYPSUM BOARD ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Nonload-bearing steel framing members for gypsum board and/or assemblies.
  - 2. Gypsum board assemblies attached to steel framing.
  - 3. Sound attenuation blankets.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 5 Section "Cold-Formed Metal Framing" for exterior walls and/or interior locations where cold formed metal framing is required to meet load and deflection criteria.
  - 2. Division 7 Section "Building Insulation" for thermal batt insulation.
  - 3. Division 7 Section "Firestopping" for firestopping systems and fire-resistance-rated joint sealants.
  - 4. Division 9 Section "Gypsum Sheathing" for installations over steel framing.
  - 5. Division 9 Section "Gypsum Board Shaft Wall Assemblies" for shaft wall framing and panels.

#### **1.3 DEFINITIONS**

- A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

#### **1.4 ASSEMBLY PERFORMANCE REQUIREMENTS**

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
- B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

#### **1.5 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Shop Drawings showing locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- D. Product certificates signed by manufacturers of gypsum board assembly components certifying that their products comply with specified requirements.

## 1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- D. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
  - 1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum panels flat to prevent sagging.

## 1.8 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.



- B. Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F (10 deg C) for 48 hours before application and continuously after until dry. Do not exceed 95 deg F (35 deg C) when using temporary heat sources.
- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

- 1. Steel Framing and Furring:

- a. Clark/Dietrich Industries, Inc.
- b. Consolidated Systems, Inc.
- c. Telling Industries
- d. MBA Metal Framing
- e. Southeastern Metals, SEMCO
- f. National Gypsum Co.; Gold Bond Building Products Division.
- g. Steel Structural Products LLC

- 2. Gypsum Board and Related Products:

- a. Domtar Gypsum.
- b. Georgia-Pacific Corp.
- c. National Gypsum Co.; Gold Bond Building Products Division.
- d. United States Gypsum Co.

### 2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS

- A. General: Provide components complying with ASTM C 754 for conditions indicated.
- B. Cast-in-Place and Postinstalled Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials, with holes or loops for attaching hanger wires, and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.
  - 1. Cast-in-place type designed for attachment to concrete forms.
  - 2. Expansion anchor.
- C. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190

conducted by a qualified independent testing agency.

- D. Wire Ties: ASTM A 641, Class I zinc coating, soft temper, 0.062 inch thick.
- E. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- F. Hanger Rods: Mild steel and zinc coated or protected with rust-inhibitive paint.
- G. Channels: Cold-rolled steel, 0.0598-inch (1.5-mm) minimum thickness of base (uncoated) metal and 7/16-inch- (11.1-mm-) wide flanges, and as follows:
  - 1. Carrying Channels: 1-1/2 inches (38.1 mm) deep, 475 lb/1000 feet (70 kg/100 m), unless otherwise indicated.
  - 2. Finish: ASTM A 653, G 60 (ASTM A 653M, Z 180) hot-dip galvanized coating.
- J. Steel Rigid Furring Channels: ASTM C 645, galvanized, hat shaped, depth of 7/8 inch (22.2 mm), and minimum thickness of base (uncoated) metal as follows:
  - 1. Thickness: Actual 20 gauge (33 mils), unless otherwise indicated.

## 2.3 STEEL FRAMING FOR WALLS, PARTITIONS, AND BULKHEADS OR HORIZONTALLY FRAMED CEILINGS AND FURRINGS

- A. General: Provide steel framing members complying with the following requirements:
  - 1. Component Sizes and Spacings: As indicated but not less than that required to comply with ASTM C 754 under the following maximum deflection and lateral loading conditions:
    - a. Maximum Deflection: L/240 at 5 lbf per Sq. Ft.
  - 2. Protective Coating: ASTM A 653, G 40 (ASTM A 653M, Z 90) hot-dip galvanized coating.
- B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch- (5-mm-) wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
  - 1. Thickness: Actual 20 gauge (33 mils) minimum unless otherwise indicated.
  - 2. Depth: As indicated.
- C. Steel Rigid Furring Channels: ASTM C 645, hat shaped, depth and minimum thickness of base (uncoated) metal as follows:
  - 1. Thickness: Actual 20 gauge (33 mils) minimum unless otherwise indicated.
  - 2. Depth: 7/8 inch.
- D. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding

power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

## 2.4 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.
- B. Gypsum Wallboard: ASTM C 36 and as follows:
  - 1. Type: Type X at all locations.
  - 2. Edges: Tapered.
  - 3. Thickness: 5/8 inch.
- C. Gypsum Board Base Layer(s) for Multilayer Applications: Gypsum wallboard, ASTM C 36, and as follows:
  - 1. Type: Type X at all locations.
  - 2. Edges: Manufacturer's standard.
  - 3. Thickness: 5/8 inch.
- D. Mold and Moisture Resistant Gypsum Wallboard: ASTM C36/C and ASTM C1177/C with moisture and mold resistant core and surface for use at locations specifically indicated or scheduled. **(Generally required on the inside face of all exterior walls, all walls and/or ceilings in Elevator Shafts, Restrooms, Janitor Closets, Mechanical Rooms, Sprinkler Riser/Equipment Rooms, wall areas within 4' adjacent sinks or water fountains, gypsum board attached directly on the underside of attic trusses, and portions of fire walls or sound walls that extend through attic areas to roof decks)**
  - 1. Type: Type X.
  - 2. Edges: Tapered.
  - 3. Thickness: 5/8 inch
- E. Impact Resistant/Mold and Moisture Resistant Gypsum Wallboard: ASTM C36/C and ASTM C1177/C with moisture and mold resistant core and surface. Provide this type Gypsum Board at locations specifically indicated or scheduled up to a minimum height of 8'-0" above finished floors. **(Generally all walls (interior and inside face of exterior) at Lobbies and "Hangout" spaces, Corridors, Stairwells, Storage Rooms, the Makerspace, Wood and Metal Shops).**
  - 1. Type: Type X at all locations.
  - 2. Edges: Tapered
  - 3. Thickness: 5/8 inch
  - 4. Complying Products:
    - a. National Gypsum - Gold Bond Hi-Impact XP Gypsum Board.
    - b. Georgia-Pacific - Densarmor Plus Impact Resistant.
- G. Note: only Mold and Moisture Resistant Gypsum Wallboard products, as specified, may be installed at any interior gypsum board installation areas that the Contractor deems necessary to take place before the exterior building envelope is fully sealed and humidity levels can be

**continuously controlled with the use of portable HVAC units and/or dehumidifiers.**

Otherwise, either delay furnishing and installing standard gypsum wallboard in areas permitted to use such until the building envelope is adequately sealed and humidity levels can be controlled or substitute standard gypsum products with Mold and Moisture Resistant rated products specified herein.

## 2.5 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim, and control joints complying with ASTM C 1047 and requirements indicated below:
  - 1. Material: Formed metal or plastic, with metal complying with the following requirement:
    - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
  - 2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
    - a. Cornerbead on outside corners, unless otherwise indicated.
    - b. LC-bead with both face and back flanges; face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
    - c. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead where indicated.
    - d. U-bead with face and back flanges; face flange formed to be left without application of joint compound. Use U-bead where indicated.
    - e. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
- B. Aluminum Accessories: Where indicated, provide manufacturer's standard extruded-aluminum accessories of profile indicated complying with the following requirements:
  - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for alloy and temper 6063-T5.
  - 2. Powder Coated Finish: Manufacturer's standard Powder Coated Finish in color as selected by Architect from full range of available colors.
  - 3. Manufacturer: Subject to compliance with requirements, provide aluminum accessories by one of the following:
    - a. Fry Reglet Corp.
    - b. Gordon, Inc.
    - c. MM Systems, Inc.
    - d. Pittcon Industries, Inc.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C 475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board: Paper reinforcing tape, unless otherwise indicated.
- C. Drying-Type Joint Compounds for Gypsum Board: Factory-packaged vinyl-based products complying with either of the following requirements for formulation and intended use.
  - 1. Ready-Mixed Formulation: Factory-mixed product.
    - a. All-purpose compound formulated for both taping and topping compounds . Where mold & moisture resistant gypsum board is installed joint compound used shall be product as recommended by Drywall Manufacturer for enhanced resistance to mold.
  - 2. Job-Mixed Formulation: Powder product for mixing with water at Project site.
    - a. All-purpose compound formulated for both taping and topping compounds. Where mold & moisture resistant gypsum board is installed joint compound used shall be product as recommended by Drywall Manufacturer for enhanced resistance to mold.

## 2.7 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
  - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
- C. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
    - b. SHEETROCK Acoustical Sealant; United States Gypsum Co.
    - c. Quietseal Pro Acoustical Sealant; Pabco Building Products
  - 2. Acoustical Sealant for Concealed Joints:
    - a. BA-98; Pecora Corp.
    - b. Tremco Acoustical Sealant; Tremco, Inc.

## 2.8 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
- C. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot-grouting hollow metal door frames.
- D. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- E. Steel drill screws complying with ASTM C 1002 for the following applications:
  - 1. Fastening gypsum board to steel members less than 0.033 inch (0.84 mm) thick.
  - 2. Fastening gypsum board to gypsum board.
- F. Steel drill screws complying with ASTM C 954 for fastening gypsum board to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- G. Sound-Attenuation Blankets: Unfaced mineral-fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing).
  - 1. Mineral-Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.
- H. Heavy Gauge Sheet Metal Backing Plates: Provide 16 ga. minimum galvanized sheet metal back-up plates for mounting of Millwork, Toilet Accessories, Visual Display Boards, Signage, LCD/TV Monitors, Window Treatments, Light Fixtures, etc. as required to adequately anchor wall and/or ceiling mounted items. Contractor may substitute and/or supplement with rough carpentry wood blocking at specific areas as required.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Ceiling Anchorages: Coordinate installation of ceiling suspension systems with installation of overhead structural assemblies to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers that will develop their full strength

and at spacing required to support ceilings.

- B. Before sprayed-on fireproofing is applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fireproofing. Where offset anchor plates are required, provide continuous units fastened to building structure not more than 24 inches (600 mm) o.c.
- C. After sprayed-on fireproofing has been applied, remove only as much fireproofing as needed to complete installation of gypsum board assemblies without reducing thickness of fireproofing below that is required to obtain fire-resistance rating indicated. Protect remaining fireproofing from damage.

### 3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.
- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

### 3.4 INSTALLING STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Suspend ceiling hangers from building structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  - 4. Secure flat, angle, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices and fasteners that are secure and appropriate

for structure as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or otherwise fail.

5. Do not support ceilings directly from permanent metal forms.
  6. Do not attach hangers to steel deck tabs.
  7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Sway-brace suspended steel framing with hangers used for support.
- C. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.
1. Wire Hangers: 48 inches (1219 mm) o.c.
  2. Carrying Channels (Main Runners): 48 inches (1219 mm) o.c.
  3. Furring Channels (Furring Members): 16 inches (406 mm) o.c.
- D. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.
- E. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

### 3.5 INSTALLING STEEL FRAMING FOR WALLS, PARTITIONS AND BULKHEADS

- A. Install runners (tracks) at floors, ceilings, and structural walls and columns where gypsum board stud assemblies abut other construction.
- B. Installation Tolerances: Install each steel framing and furring member so that fastening surfaces do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at or immediately above suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
  2. For STC-rated and fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- D. Install steel studs and furring in sizes and at spacings indicated.



1. Single- and Multi-Layer Construction: Space studs 16 inches (406 mm) o.c., unless otherwise indicated.
- E. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- F. Frame door openings to comply with GA-219, and with applicable published recommendations of gypsum board manufacturer, unless otherwise indicated. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
1. Install 2 studs at each jamb, unless otherwise indicated.
  2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (12.7-mm) clearance from jamb stud to allow for installation of control joint.
  3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.
- G. Frame openings other than door openings to comply with details indicated or, if none indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.

### 3.6 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
- B. Install sound-attenuation blankets, where indicated, prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install gypsum panels with face side out. Do not install imperfect, damaged, or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Spot grout hollow metal door frames for solid-core wood doors, hollow metal doors, and doors over 32 inches (813 mm) wide. Apply spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- H. Form control and expansion joints at locations indicated and as detailed, with space between edges of

adjoining gypsum panels, as well as supporting framing behind gypsum panels.

- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases that are braced internally.
  - 1. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect open concrete coffer, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffer, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- J. Isolate perimeter of nonload-bearing gypsum board partitions at structural abutments, except floors, as detailed. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings, and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

### 3.7 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:
  - 1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated, and provide panel lengths that will minimize end joints.
- B. Wall Tile Substrates: Unless otherwise noted, for substrates indicated to receive thin-set ceramic tile comply with the following:
  - 1. Install 5/8" mold and moisture resistant gypsum backing board panels unless otherwise specified. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or penetrations.
- C. Multilayer Application on Ceilings: Apply gypsum board indicated for base layers prior to

applying base layers on walls/partitions; apply gypsum wallboard face layers in same sequence. Offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints. Apply base layers at right angles to framing members, unless otherwise indicated.

- D. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and gypsum wallboard face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints. Stagger joints on opposite sides of partitions.
- E. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:
  - 1. Fasten with screws.
- F. Multilayer Fastening Methods: Apply base layers of gypsum panels and face layer to base layers as follows:
  - 1. Fasten both base layers and face layers separately to supports with screws.
- G. Direct-Bonding to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.

### 3.8 INSTALLING TRIM ACCESSORIES

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.
  - 1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
  - 2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
  - 3. Install aluminum trim and other accessories where indicated.
- D. Install control joints according to ASTM C 840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

### 3.9 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.

- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
  - 1. Level 1 for ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
  - 2. Level 2 where panels form substrates for tile and where indicated.
  - 3. Level 4 for gypsum board surfaces, unless otherwise indicated (painted walls and ceilings and walls with wallcoverings).
  - 4. Level 5 for gypsum board surfaces where indicated (ceiling furr downs and bulkheads).
- E. Where Level 5 gypsum board finish is indicated, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories; and apply a thin, uniform skim coat of joint compound over entire surface. For skim coat, use joint compound specified for third coat, or a product specially formulated for this purpose and acceptable to gypsum board manufacturer. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects, tool marks, and ridges and ready for decoration.
- F. For Level 4 gypsum board finish, embed tape in joint compound and apply first, fill (second), and finish (third) coats of joint compound over joints, angles, fastener heads, and accessories. Touch up and sand between coats and after last coat as needed to produce a surface free of visual defects and ready for decoration.
- G. Where Level 2 gypsum board finish is indicated, embed tape in joint compound and apply first coat of joint compound.
- H. Where Level 1 gypsum board finish is indicated, embed tape in joint compound.

### 3.10 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  - 1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.

### 3.11 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.

- B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 09 25 50

## SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes ceilings composed of acoustical panels and exposed suspension systems.

#### 1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection in the form of manufacturer's color charts consisting of actual acoustical panels or sections of panels and sections of suspension system members showing the full range of colors, textures, and patterns available for each ceiling assembly indicated.
- D. Samples for verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
  - 1. 6-inch- (150-mm-) square samples of each acoustical panel type, pattern, and color.
  - 2. Set of 12-inch- (300-mm-) long samples of exposed suspension system members, including moldings, for each color and system type required.
- E. Product test reports from a qualified independent testing agency that are based on its testing of current products for compliance of acoustical panel ceilings and components with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
  - 1. Fire-response tests are performed by a qualified testing and inspecting agency.

Qualified testing and inspecting agencies include Underwriters Laboratories (UL), Warnock Hersey, or another agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.

2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
  3. Acoustical panel ceilings indicated are identical in materials and construction to those tested for fire resistance per ASTM E 119.
  4. Fire-resistance-rated, acoustical panel ceilings are indicated by design designations listed in the UL "Fire Resistance Directory," in the Warnock Hersey "Certification Listings," or in the listing of another qualified testing and inspecting agency.
  5. Products are identified with appropriate markings of applicable testing and inspecting agency.
- C. Single-Source Responsibility for Ceiling Panel and Suspension System Units: Obtain each type of acoustical ceiling panel and suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

#### 1.6 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any),

and partition assemblies (if any).

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
  - 1. Acoustical Ceiling Units: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
  - 2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2.0 percent of amount installed.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include the products specified in each Acoustical Panel Ceiling Product Data Sheet at the end of this Section.

### 2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
  - 1. Mounting Method for Measuring Noise Reduction Coefficient (NRC): Type E-400 (plenum mounting in which face of test specimen is 15-3/4 inches [400 mm] away from the test surface) per ASTM E 795.
  - 2. Test Method for Ceiling Attenuation Class (CAC): Where acoustical panel ceilings are specified to have a CAC, provide units identical to those tested per ASTM E 1414 by a qualified testing agency.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
- C. Panel Characteristics: Comply with requirements indicated on each Acoustical Panel Ceiling Product Data Sheet at the end of this Section, including those referencing ASTM E 1264 classifications.

### 2.3 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.
- B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of



system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
1. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attachment of hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing agency.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated Carbon Steel Wire: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper.
  2. Size: Select wire diameter so that its stress at 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung) will be less than the yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Hanger Rods: Mild steel, zinc coated.
- F. Flat Hangers: Mild steel, zinc coated.
- G. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide, formed with 0.0396-inch- (1-mm-) thick galvanized-steel sheet complying with ASTM A 446, G 90 (ASTM A 446M, Z 275) Coating Designation, with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- H. Sheet-Metal Edge Moldings and Trim: Type and profile indicated, or if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.
- I. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For interior ceilings composed of acoustical panels weighing less than 1 lb per sq. ft. (4.88 kg per sq. m), provide hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.
- 2.4 NON-FIRE-RESISTANCE-RATED, DIRECT-HUNG SUSPENSION SYSTEMS
- A. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from pre-painted or electrolytic zinc-coated, cold-rolled steel sheet, with prefinished 5/16-inch- (8-mm-) wide metal caps on flanges; other characteristics as

follows:

1. Structural Classification: Intermediate-duty system.
  2. End Condition of Cross Runners: Override (stepped) type.
  3. Cap Material and Finish: Steel sheet painted white.
- B. Wide-Face, Aluminum Capped Aluminum Suspension System: Main and cross runners roll formed from Double Web Type 304 Aluminum , with prefinished 15/16-inch-(24-mm-) wide aluminum caps on flanges; other characteristics as follows:
1. Structural Classification: Intermediate-duty system.
  2. Finish: Painted white.
- C. Available Products: Subject to compliance with requirements, suspension systems that may be incorporated in the Work include, but are not limited to, the following:
1. Wide-Face, Capped, Double-Web, Steel Suspension Systems:
    - a. Prelude 15/16" Exposed Tee System; Armstrong World Industries, Inc. (Basis of Design)
    - b. DX 24 System; USG Interiors, Inc.
  2. Wide-Face, Aluminum-Capped, Double-Web, Aluminum Suspension Systems:
    - a. .Prelude Plus 15/16" XL Aluminum; Armstrong World Industries, Inc. (Basis of Design)
    - b. Donn AX/AXCE Grid System; USG Interiors, Inc.

## 2.5 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed or Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following requirements:
1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints to reduce transmission of airborne sound.
- C. Available Products: Subject to compliance with requirements, acoustical sealants that may be incorporated in the Work include, but are not limited to, the following:

- D. Acoustical Sealant for Exposed or Concealed Joints:
  - 1. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
  - 2. SHEETROCK Acoustical Sealant; United States Gypsum Company.
- E. Acoustical Sealant for Concealed Joints:
  - 1. BA-98; Pecora Corp.
  - 2. Tremco Acoustical Sealant; Tremco, Inc.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Measure each ceiling area and establish the layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and conform to the layout shown on reflected ceiling plans.

#### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's instructions and CISCA "Ceiling Systems Handbook."
  - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
  - 2. CISCA Recommendations for Acoustical Ceilings: Comply with CISCA "Recommendations for Direct-Hung Acoustical Tile and Lay-In Panel Ceilings."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
  - 2. Splay hangers only where required, and if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to

support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers either directly to structures or to inserts, eye screws, or other devices that are secure, that are appropriate for substrate, and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Do not support ceilings directly from permanent metal forms. Fasten hangers to powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
  6. Do not attach hangers to steel deck tabs.
  7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise shown; and provide hangers not more than 8 inches (200 mm) from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not over 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.18 mm in 3.66 m). Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. Install panels with pattern running in one direction parallel to long axis of space.
  2. For reveal-edged panels on suspension system runners and mouldings, install panels with bottom of reveal in firm contact with top surface of flanges.

3. Paint the cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended for this purpose by acoustical panel manufacturer.
4. Install hold-down clips in areas required by governing regulations, for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.
5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

#### 3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

#### 3.5 ACOUSTICAL PANEL CEILING PRODUCT DATA SHEET

- A. **Acoustical Panel Ceiling Designation: Suspended Acoustical Type I.** Acoustical Panel Characteristics: Provide panels complying with ASTM E 1264 for characteristics described below:
  1. Pattern and Type: Type III, Form 1, Pattern E1 acoustical panels with painted finish and mold/mildew inhibitor as follows:
    - a. Non-Fire-Resistance Rated, Mineral Fiber Panels:
      - 1.) Fine Fissured (#1728 Humigard Plus): Armstrong World Industries. (Basis of Design)
      - 2.) Radar Clima Plus, USG Interiors
  2. Color: White.
  3. Non-Sag Warranty: 10 Year minimum
  4. Light Reflectance Coefficient: 0.80 minimum.
  5. Noise Reduction Coefficient: 0.50 minimum.
  6. Ceiling Sound Transmission Class: 35 minimum
  7. Edge Detail: Square cut lay-in
  8. Size: 24 x 24 inches.
  9. Thickness: 5/8" inches minimum.
  10. Suspension System Type: Provide suspension system that complies with requirements in Part 2, products and the following:
    - a. Non-Fire-Resistance Rated, Direct Hung Standard Suspension System: Provide at all rooms or areas except those indicated to be "Wet" areas as listed below.

**B. Acoustical Panel Ceiling Designation: Suspended Acoustical Type II.** Where this or “Wet Area” Ceiling Tile designation is indicated (Restrooms and Janitor Closets and/or other rooms as Scheduled on the Plans), Acoustical Panel Characteristics: Provide panels complying with ASTM E 1264 for characteristics described below:

1. Pattern and Type: Type XX, Pattern C, E, & G Mineral Fiber acoustical panels with bonded ceramic finish and mold/mildew inhibitor as follows:
  - a. Non-Fire-Resistance Rated, Mineral Fiber Panels:
    - 1.) Ceramaguard Fine Fissured Perforated 607: Armstrong World Industries.(Basis of Design)
    - 2.) Radar Ceramic Acoustical Panels 56644: USG Interiors
2. Color: White.
3. Light Reflectance Coefficient: 0.79 minimum
4. Noise Reduction Coefficient: 0.50 minimum
5. Ceiling Sound Transmission Class: 38 minimum
6. Edge Detail: Square.
7. Thickness: 5/8 inch minimum.
8. Size: 24 x 24 inches.
9. Sag Guarantee: 10 year minimum.
10. Suspension System Type: Provide suspension system that complies with requirements in Part 2, products and the following:
  - a. Non-Fire-Resistance Rated, Direct Hung Aluminum Capped -Aluminum Suspension System: Provide at all rooms with Wet Area Type II Acoustical Ceiling Panels

END OF SECTION 09 51 13

## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Resilient wall base.
  - 2. Resilient flooring accessories.
  - 3. Resilient carpet accessories.
  - 4. Resilient coved stair riser and tread/nosing accessories
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 9 Section "Resilient Tile Flooring" for LVT and Radial Rubber Flooring.
  - 2. Division 9 Section "Carpet Tile" for Carpet Tile Flooring.

#### **1.3 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for each type of product specified.
- C. Samples for initial selection purposes of manufacturer's standard sample sets in form of pieces cut from each type of product specified showing full range of colors and patterns available.
- D. Product certificates, in lieu of laboratory test reports when permitted by Architect, signed by manufacturer certifying that each product complies with requirements.

#### **1.4 QUALITY ASSURANCE**

- A. Single-Source Responsibility for Products: Obtain each type and color of product specified from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the Work.
- B. Fire Performance Characteristics: Provide products with the following fire performance characteristics as determined by testing products per ASTM test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Critical Radiant Flux: 0.45 watts per sq. cm or more per ASTM E 648.

2. Smoke Density: Less than 450 per ASTM E 662.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original manufacturer's unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather with ambient temperatures maintained between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- C. Move products into spaces where they will be installed at least 48 hours in advance of installation.

#### 1.6 PROJECT CONDITIONS

- A. Maintain a minimum temperature of 70 deg F (21 deg C) in spaces to receive products specified in this Section for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. After this period, maintain a temperature of not less than 55 deg F (13 deg C).
- B. Do not install products until they are at the same temperature as that of the space where they are to be installed.
- C. Close spaces to traffic during installation of products specified in this Section.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Sequence installing products specified in this Section with other construction to minimize possibility of damage and soiling during remainder of construction period.

#### 1.8 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.
  1. Furnish not less than 10 linear feet for each 500 linear feet or fraction thereof of each different type and color of resilient wall base installed.
  2. Furnish not less than 6 linear feet of each different type of resilient edge strip or reducer.
  3. Furnish not less than 10 linear feet for each 500 linear feet of each different type and color of resilient tread nosing and straight and coved riser trim.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS



- A. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include those specified in each Product Data Sheet at end of this Section.

## 2.2 RESILIENT WALL BASE

- A. Rubber Wall Base: Products complying with FS SS-W-40, Type I, and requirements specified in the Rubber Wall Base Product Data Sheet at end of this Section.

## 2.3 RESILIENT STAIR ACCESSORIES

- A. Rubber Stair Treads: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A, and requirements specified in Rubber Stair Accessory Product Data Sheet at end of this Section.
- B. Risers: Product of same manufacturer as stair treads and complying with requirements specified in Stair Accessory Data Sheet at end of this Section.

## 2.4 RESILIENT ACCESSORIES

- A. Rubber Accessories: Products complying with FS RR-T-650 requirements specified in Rubber Accessory Data Sheet at end of this section.

## 2.5 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Nonstaining type as recommended by flooring manufacturer.
- B. Stair Tread Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates not conforming to tread contours.
- C. Trowelable Underlayments and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- D. Adhesives: Water-resistant type recommended by manufacturer to suit resilient flooring product and substrate conditions indicated.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas where installation of products specified in this Section will occur, with Installer present, to verify that substrates and conditions are satisfactory for installation and comply with manufacturer's requirements and those specified in this Section.

## 3.2 PREPARATION

- A. General: Comply with manufacturer's installation specifications for preparing substrates indicated to receive products indicated.

- B. Use trowelable leveling and patching compounds per manufacturer's directions to fill cracks, holes, and depressions in substrates.
- C. Use stair tread nose filler per tread manufacturer's directions to fill nosing substrates not conforming to tread contours.
- D. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- E. Broom or vacuum clean substrates to be covered immediately before installing products specified in this Section. Following cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.
- F. Apply concrete slab primer, if recommended by flooring manufacturer, prior to applying adhesive. Apply according to manufacturer's directions.

### 3.3 INSTALLATION

- A. General: Install products specified in this Section using methods indicated according to manufacturer's installation directions.
- B. Apply resilient wall base to walls, columns, pilasters, casework, and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
  - 1. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
  - 2. Install exterior corners before installing straight pieces.
  - 3. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
- C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.
- D. Apply resilient accessories to stairs as indicated and according to manufacturer's installation instructions.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing installation:
  - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by manufacturers of resilient product involved.

2. Sweep or vacuum floor thoroughly.
  3. Do not wash floor until after time period recommended by manufacturer.
  4. Damp-mop resilient accessories to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended by manufacturer of resilient product involved.

### 3.5 RESILIENT WALL BASE PRODUCT DATA SHEET

- A. Material: Type TS 100% Rubber
- B. Style: Cove with top-set toe.
- C. Minimum Nominal Thickness: 1/8 inch.
- D. Height: 4 inches.
- E. Lengths: Cut lengths 4 feet long, or coils in lengths standard with manufacturer but not less than 100 feet.
- F. Exterior Corners: Premolded only.
- G. Interior Corners: Job-formed only.
- H. Color and Pattern: To be selected by Architect from manufacturers full range of products.
- I. Available Manufacturers:
  1. Burke
  2. Flexco
  3. Azrock-Johnsonite-Tarkett
  4. Endura
  5. Roppe
  6. Mercer
  7. Mondo
  8. Pirelli

### 3.6 RUBBER STAIR ACCESSORY DATA SHEET

- A. Rubber Stair Treads: Type 2 design (designed) products complying with the following requirements.
  1. Type 2 Design: Raised disc. (Tread nosing profile shall be Architect approved with 2" contrasting visually impaired strip)
  2. Nosing Style: Square with angle to match stair riser where applicable.

3. Nosing Height: As follows, measured from top of tread to bottom edge of nosing.
    - a. 2 inches.
  4. Thickness: 1/4 inch tapering to 3/16 inch at back edge.
  5. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, in equal length units.
- B. Rubber Risers: Smooth flat risers with or without cover toe (as selected by Architect) 1/8 inch thick by height and length to cover risers.
- C. Rubber Stringers: Not required.
- D. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for rubber stair accessories complying with requirements indicated.
- E. Available Manufacturers: Afco, Endura, Flexco, Johnsonite, Mondo, Pirelli, Roppe.
1. Note: Manufacturer must be same as that furnished for Rubber Floor Tile.

### 3.6 RUBBER ACCESSORY PRODUCT DATA SHEET

- A. Product Description: Carpet edge for glue down applications, reducer strip for resilient flooring and tile/carpet joiner and other flooring type transition/reducer strips as required.
- B. Profile and Dimensions: To be selected by Architect from manufacturers full range of products.
- C. Color: To be selected by Architect from manufacturers full range of products.
- D. Available Manufacturers:
1. Burke
  2. Flexco
  3. Endura
  4. Johnsonite
  5. Roppe
  6. Mercer
  7. Azrock
  8. Mondo
  9. Pirelli

END OF SECTION 09 65 13

## **SECTION 09 65 19 - RESILIENT TILE FLOORING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Luxury Vinyl Tile
  - 2. Radial Rubber Floor Tile

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

#### **1.5 EXTRA MATERIALS**

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
  - 1. Full-size units equal to 5 percent of amount installed for each type indicated.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

## 2.2 LUXURY VINYL TILE

- A. Subject to compliance with requirements, provide one of the following:
  - 1. LVT-1:
    - a. Mannington, Spacia Abstract, Stellar Grey
    - b. Tarkett, ID Latitude Abstract, Vapor
    - c. Or prior approved equal
  - 2. LVT-2:
    - a. Mannington, Spacia Abstract, Stellar Ash
    - b. Tarkett, ID Latitude Abstract, Windfresh
    - c. Or prior approved equal.
- B. Tile Standard: ASTM F 1700:
  - 1. Class: III
  - 2. Type: B performance standards for solid vinyl floor tile
  - 3. Wearing Surface: Smooth.
- C. Construction: Luxury vinyl tile
- D. Total Thickness: 2.5 – 3.0 mm (must be pre manufacturer's standard running line)
- E. Wear Layer: 30 mil minimum
- F. Size: 18 by 18 inches
- G. Installation Pattern: Architect to determine installation pattern. Assume 50% use of LVT-1 and 50% use of LVT-2 in the pattern.

## 2.3 MOLDED PATTERN RUBBER FLOOR TILE

- A. Products complying with ASTM F 1344 and requirements noted below.
- B. Class: Class I-A Homogenous Rubber Tile, Solid Color
- C. Hardness: Durometer hardness standard with tile manufacturer in lieu of minimum value specified in ASTM F 1344, but not less than 80, Shore Type A.
- D. Overall Thickness: 0.155" minimum.
- E. Size: Manufacturers standard size square tiles but not less than 17.813" square.
- F. Molded Pattern Figure: Raised discs.
- G. Color: As selected by Architect from manufacturer's full range of colors produced for molded tile of wearing surface pattern, thickness, and size specified to match stair treads.

H. Available Manufacturers: Subject to compliance with requirements, provide one of the following:

1. Afco, Endura, Flexco, Jason, Johnsonite, Mondo, Pirelli, Roppe.
2. Note: Manufacturer must be same as that furnished for Resilient Rubber Stair Accessories.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives and/or Sealers: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated. Provide combination of sealer and adhesive to meet RH and PH Levels specified below:
1. Provide adhesive or adhesive and sealer resistant to high relative humidity moisture emission levels and elevated PH, Water-Resistant, mildew-resistant, non-staining type to suit products and subfloor conditions indicated and to comply with flammability requirements for installed flooring as recommended by the flooring manufacturer for installations with up to 10 lbs. (MVER)/98% Relative Humidity (RH) and a PH of up to 12.0.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. General: Examine areas where installation of tiles will occur, with Installer present, to verify that substrates and conditions are satisfactory for tile installation and comply with tile manufacturer's requirements and those specified in this Section.

### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 12 PH.
  4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas. Perform the following type tests as recommended by the flooring

manufacturer:

- a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 10 lbs. of water/1000 sq. ft. in 24 hours unless higher levels are allowed by manufacturer's adhesives and recommendations.
  - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 95 percent relative humidity level measurement unless higher levels are allowed by manufacturer's adhesives and recommendations.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut



covers and to cover perimeters.

- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections. Provide substrate sealer prior to application of adhesive where recommended by manufacturer.
- I. Hand roll tiles where recommended by manufacturer.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing tile installation:
  - 1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers.
  - 2. Sweep or vacuum floor thoroughly.
  - 3. Do not wash floor until after time period recommended by resilient floor tile manufacturer.
  - 4. Damp-mop tile to remove black marks and soil.
- B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer.
  - 1. Cover tiles with undyed, untreated building paper until inspection for Substantial Completion or restrain all traffic from rooms with completed flooring.
  - 2. Do not move heavy and sharp objects directly over tiles. Place plywood or hardboard panels over tiles and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 65 19

## **SECTION 09 91 00 - PAINTING**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.
  - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop-priming and surface treatment specified under other Sections.
- B. Paint exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
  - 1. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
  - 1. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 5 Sections for shop-priming ferrous metal where applicable.
  - 2. Division 7 Section "Water Repellents" for clear water repellents on exterior brick unit masonry and cast stone elements.
  - 3. Division 7 Section "Intumescent Fire Resistant Materials" for intumescent fire retardant painting including decorative topcoats of exterior and interior exposed structural steel where noted on plans.
  - 4. Division 7 Section "Traffic Toppings" for waterproofing pedestrian traffic coatings applied to exterior concrete floors, landings and stairs where indicated.
  - 5. Division 8 Section "Standard Steel Door Frames" for shop-priming steel doors and frames.
  - 6. Division 8 Section "Flush Wood Doors" for factory finished wood doors.

#### **1.3 SUBMITTALS**

- A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each paint system specified, including block fillers and primers.
  - 1. Provide the manufacturer's technical information including label analysis and instructions for handling, storage, and application of each material proposed for use.
  - 2. List each material and cross-reference the specific coating, finish system, and application. Identify each material by the manufacturer's catalog number and general classification.
  - 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- C. Samples for initial color selection in the form of manufacturer's color charts.

#### 1.4 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.
- B. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.
- C. Field Samples: On wall surfaces and other interior components provide full-coat finish samples on at least 100 sq. ft. of surface until required sheen, color, and texture are obtained; simulate finished lighting conditions for review of in-place work.
  - 1. Final acceptance of colors will be from job-applied samples.
  - 2. The Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted. Apply coatings in this room or surface according to the schedule or as specified.
    - a. After finishes are accepted, this room or surface will be used to evaluate coating systems of a similar nature.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
  - 1. Product name or title of material.
  - 2. Product description (generic classification or binder type).
  - 3. Manufacturer's stock number and date of manufacture.
  - 4. Thinning instructions.
  - 5. Application instructions.
  - 6. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

## 1.6 JOB CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
  1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
  1. Benjamin Moore and Co. (Moore).
  2. PPG Paints (PPG).
  3. The Sherwin-Williams Company (S-W).
  4. H&C Concrete Coatings (H&C)
  5. Tuff-Top Coatings (Tuff-Top)
  6. Tnemec Company, Inc. (Tnemec)
- B. Refer to Product Data for each Prior Approved Paint Type at end of this Section.

### 2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
  1. Proprietary Names: Use of manufacturer's proprietary product names to designate materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed prior approval.
- C. Colors: Provide color selections made by the Architect from the manufacturer's full range of standard colors.

## 2.3 PRIMERS

- A. Primers: Provide the manufacturer's recommended factory-formulated primers that are compatible with the substrate and finish coats indicated.

## 2.4 UNDERCOAT MATERIALS

- A. Undercoat Materials: Provide the manufacturer's recommended factory-formulated undercoat materials that are compatible with the substrate and finish coats indicated.

## 2.5 EXTERIOR FINISH PAINT MATERIAL

- A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.

## 2.6 INTERIOR FINISH PAINT MATERIAL

- A. Finish Paint: Provide the manufacturer's recommended factory-formulated finish-coat materials that are compatible with the substrate and undercoats indicated.

## 2.7 MISCELLANEOUS WOOD-FINISHING MATERIALS

- A. Wood-Finishing Materials: Provide the manufacturer's recommended factory-formulated, wood-finishing materials that are compatible with the substrate and undercoats indicated.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
  - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected.
  - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

## 3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that

could impair the bond of the various coatings. Remove any oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

- C. Surface Preparation: Clean and prepare surfaces to be painted according to the manufacturer's instructions for each substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
  2. Cementitious Materials: 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.
    - a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.
    - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. 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 content exceeds that permitted in manufacturer's printed directions.
    - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
  3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
    - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    - b. Prime, stain, or seal wood to be painted immediately upon delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.
    - c. When transparent finish is required, backprime with spar varnish.
    - d. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately upon delivery.
  4. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop-coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Paint manufacturer.
    - a. Blast steel surfaces clean as recommended by the paint system manufacturer.
    - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

- c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
- 5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Materials Preparation: Carefully mix and prepare paint materials according to manufacturer's directions.
  - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  - 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
  - 3. Use only thinners approved by the paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to facilitate identification of each coat where multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.3 APPLICATION

- A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  - 1. Paint surface treatments and finishes are indicated in the schedules.
  - 2. Provide finish coats that are compatible with primers used.
  - 3. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
  - 4. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
  - 5. The term exposed surfaces includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  - 6. Paint surfaces behind movable equipment and furniture the same as similar exposed

surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, nonspecular black paint.
  8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
  10. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
  11. Sand lightly between each succeeding enamel or varnish coat.
  12. Omit primer on metal surfaces that have been shop-primed and touch-up painted.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- D. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.
1. Brushes: Use brushes best suited for the material applied.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
  3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- F. Mechanical and Electrical Work: Painting mechanical and electrical work is limited to items exposed in mechanical and electrical equipment rooms, in occupied spaces and all exposed exterior electrical and mechanical piping, conduit panel covers, disconnects, etc.
- G. Mechanical items to be painted include, but are not limited to, the following:
1. Piping, pipe hangers, and supports.
  2. Heat exchangers.
  3. Tanks.
  4. Ductwork (non-externally insulated).
  5. Insulation for color coding piping.



6. Supports.
7. Motors and mechanical equipment.
8. Accessory items.

H. Electrical items to be painted include, but are not limited to, the following:

1. Conduit and fittings.
2. Switchgear.
3. Disconnects.

I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.

1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.

#### 3.4 CLEANING

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

#### 3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

#### 3.6 PAINT SCHEDULE, GENERAL: Provide the following paint systems for the various substrates indicated.

A. Colors: Colors of paints (including stains) shall match color chips submitted by the Architect and

shall match approved shades in sample areas.

- B. NOTE: Contractor shall include painting of all (externally un-insulated) exposed mechanical and electrical equipment, panels, disconnects, pumps, conduit, piping, ductwork, drain lines, etc. at exterior and interior of new construction.**

### 3.7 EXTERIOR PAINTING SCHEDULE:

- A. Field Painted Galvanized Steel: Note, on new galvanized steel surfaces, prepare surface with cleaner/etch adhesion formula equal to Rust-oleum KRK-19 Krud Kutter Metal Clean and Etch prior to primer coat. First coat Inhibitive Metal Primer. Second and third coats Water Based Alkyd Urethane Semi-Gloss Enamel with mildew resistant additive.
- B. Ferrous Metals: First coat Inhibitive Metal Primer. (Touch up primer at factory or shop applied primed objects) (Use Bonding Primer where required). Second and third coats Water Based Alkyd Urethane Semi-Gloss Enamel with mildew resistant additive.
- C. Field Painted Aluminum: First coat Bonding Primer. Second and third coats Water Based Alkyd Urethane Semi-Gloss Enamel with mildew resistant additive.
- D. High Performance Coated Steel: Primer and Intermediate Coats: Two-Component Polyamide Epoxy, Finish Coat: Two Component Aliphatic Acrylic Polyurethane Topcoat.
- E. **Note: Refer to Specification Section 07 81 10 Intumescent Fire Resistant Materials for field applied intumescent coating and sealers to be painted on Exposed Shop Primed Exterior Structural Steel Members called and/or required to be coated with Intumescent Fireproofing. Decorative Top Coating to be High Performance Coated Steel as noted above except with only one coat of Two-Component Polyamide Epoxy over the Intumescent Fireproofing Sealer, then apply the finish coat of two component Aliphatic Acrylic Polyurethane. Note there is a limited duration that the intumescent sealer coat can remain in service prior to top coating. Verify duration with Intumescent Coating Manufacturer and comply with requirements as applicable.**
- F. Painted Concrete and/or Concrete Masonry Units: First Coat Masonry Filler/Primer. Second and third coats Acrylic Based Elastomeric Waterproof Coating.
- G. Paving Markings: First and second coats: Traffic Marking Paint, color as selected.

### 3.8 INTERIOR PAINTING SCHEDULE:

- A. Field Painted Galvanized Steel: First coat Inhibitive Metal Primer. (Use Bonding Primer where required). Second and third coats, High Performance Acrylic Semi-Gloss Coating. Note, on new galvanized steel surfaces, prepare surface with cleaner/etch adhesion formula equal to Rust-oleum KRK-19 Krud Kutter Metal Clean and Etch prior to primer coat.
- B. Ferrous Metals: First coat Inhibitive Metal Primer or Primer as recommended by Manufacturer (touch-up coat only at pre-primed items). Second and third coats, High Performance Acrylic Semi-Gloss Coating.
- C. Field Painted Aluminum: First coat Bonding Primer. Second and third coats Water Based Alkyd Urethane Semi-Gloss Enamel with mildew resistant additive.
- D. **Note: Refer to Specification Section 07 81 10 Intumescent Fire Resistant Materials for field applied intumescent coating to be painted on Exposed Shop Primed Interior Structural Steel**

**Members called and/or required to be coated with Intumescent Fireproofing. Decorative Top Coating to be 2 Coats of High Performance Acrylic Semi-Gloss Coating.**

- E. Gypsum Board Walls, Furr Downs, Ceilings: First coat Primer-Sealer recommended by Manufacturer, tinted with desired color. Second and third coats, Premium Acrylic Matte, Satin or Semi-Gloss Enamel as selected by Architect. (Use Satin Pre-Catalyzed Water Based Epoxy for second and third coats at areas where indicated on schedules).
- F. Plywood, Woodwork, Trim (Stained): First coat wood conditioner as recommended by stain manufacturer, second coat Semi-Transparent Alkyd-Oil Stain. On open grain woods, fill with Natural Paste Wood Filler, tinted with oil stain, before final finishing. Second and third coats, Polyurethane Satin Clear Plastic Varnish. Buff lightly with extra fine steel wool between coats.
- G. Plywood, Woodwork, Painted Wood Doors, Trim (Painted): First coat Quick Drying Enamel Undercoater. (Use Bonding Primer where required). Second and third coats, waterborne acrylic-alkyd Interior Semi-Gloss Enamel.
- H. Clear Sealed Concrete Floor Slabs: Clean, de-grease and prep/etch/abrade floor to sufficient profile. First and Second Coats, Clear Acrylic Sealer for Concrete Floors.

**3.9 PAINT PRODUCTS SCHEDULE:**

| <b>EXTERIOR PAINT SCHEDULE:</b>                      | <b>PPG PAINTS</b>                                  | <b>SHERWIN WILLIAMS</b>              |
|--|--|--------------------------------------|
| GALVANIZED STEEL PRIMER:                             | PITT TECH PLUS EP<br>DTM PRIMER 90                 | PROCRYL UNIVERSAL PRIMER<br>B66W310  |
| INHIBITIVE METAL PRIMER:                             | PITT TECH PLUS EP<br>DTM PRIMER 90                 | PROCRYL UNIVERSAL PRIMER<br>B66W310  |
| BONDING PRIMER:                                      | XIM-UMA<br>BONDING PRIMER                          | PRO-INDUSTRIAL<br>DTM BONDING PRIMER |
| WB ALKYD URETHANE:                                   | AQUACRON 870<br>ACRYLIC URETHANE                   | PRO-INDUSTRIAL WB<br>ALKYD URETHANE  |
| TWO-COMPONENT POLYAMIDE<br>EPOXY PRIMER/INTERM. COAT | AMERLOCK 600<br>AK600 SERIES                       | MACROPOXY 646<br>FC B58-600 SERIES   |
| TWO-COMPONENT ALIPHATIC<br>ACRYLIC URETHANE TOPCOAT  | DURETHANE DTM<br>MASTIC URETHANE<br>95-3300 SERIES | ACROLON ULTRA<br>B-65-830 SERIES     |
| ELASTOMERIC WATERPROOFING<br>COATING                 | PERMA-CRETE<br>PITT-FLEX 4-110XI                   | LOXON XP                             |
| TRAFFIC MARKING PAINT:                               | ZONE MARKING<br>ALKYD                              | PRO MAR TRAFFIC<br>PAINT B29         |

| <b>INTERIOR PAINT SCHEDULE:</b>                      | <b>PPG PAINTS</b>                       | <b>SHERWIN WILLIAMS</b>                            |
|--|---|--|
| INHIBITIVE METAL PRIMER:                             | PITT TECH PLUS EP<br>DTM PRIMER 90      | PROCRYL UNIVERSAL PRIMER<br>B66W310                |
| BONDING PRIMER                                       | XIM-UMA<br>BONDING PRIMER               | PRO-INDUSTRIAL<br>DTM BONDING PRIMER               |
| WB ALKYD URETHANE                                    | AQUACRON 870 WB<br>ACRYLIC URETHANE     | PRO-INDUSTRIAL WB<br>ALKYD URETHANE                |
| HIGH PERFORMANCE ACRYLIC                             | PITT-TECH PLUS EP DTM                   | SHER-CRYL HPA                                      |
| GYPSUM BOARD PRIMER/SEALER                           | SEAL GRIP<br>ACRYLIC PRIMER<br>17-921XI | MULTI-PURPOSE<br>LATEX PRIMER/SEALER<br>B51 SERIES |
| QUICK DRYING ENAMEL<br>UNDERCOATER                   | SEAL GRIP ALKYD<br>PRIMER 17-941NF      | EASY SAND ALKYD PRIMER<br>B49W8040                 |
| LATEX SATIN OR SEMI-GLOSS<br>PREMIUM ACRYLIC ENAMEL: | PROMINENCE INTERIOR<br>PREMIUM ACRYLIC  | DURATIONS INTERIOR<br>PREMIUM ACRYLC               |
| PRE-CATALYZED WB EPOXY                               | PITT GLAZE WB1                          | PRO-INDUSTRIAL<br>PRE-CATALYZED WB                 |
| WB ACRYLIC ALKYD ENAMEL                              | SPPEDHIDE WB ALKYD<br>6-1510XI          | PRO-MAR 200<br>ACRYILC ALKYD                       |
| SEMI-TRANSPARENT ALKYD-OIL STAIN:                    | DEFT INTERIOR OIL<br>PENETRATING STAIN  | WOODCLASSICS<br>OIL STAIN A49                      |
| POLYURETHANE SATIN CLEAR PLASTIC<br>VARISH:          | DEFT DFT221<br>POLYURETHANE SATIN       | POLYURETHANE<br>SATIN VARNISH<br>A67F1             |
| <b>SPECIAL PURPOSE COATINGS:</b>                     | <b>TUFF-TOP COATINGS</b>                | <b>H&amp;C CONCRETE COATINGS</b>                   |
| INTERIOR CLEAR SEALED CONCRETE                       | PAVER SEAL                              | HIGH PERFORMANCE<br>INDUSTRIAL CLEAR COAT          |
| END OF SECTION 09 91 00                              |   |  |

## **SECTION 10 14 23 - INTERIOR SIGNAGE**

### **1 GENERAL**

#### **1.1 SUMMARY**

- A. Related Documents: Provisions established within the General and Supplementary Conditions of the Contract, Division 1 - General Requirements and the Drawings are collectively applicable to this Section. Also see Section 10 14 16 Building Plaques for Cast Building Plaques.
- B. Section Includes:
  - 1. Interior signs of aluminum, Photopolymer, acrylic, and ABS plastic construction with arched face.

#### **1.2 QUALITY ASSURANCE**

- A. Supplier: Obtain all signage products in this and other signage specifications through a single supplier from a single manufacturer.
- B. Regulatory Requirements: Products shall meet requirements of the Americans With Disabilities Act Accessibility Guidelines (ADAAG) and local amendments and modifications.
- C. Installer: Installation shall be performed by installer specialized and experienced in work similar to that required for this project.
- D. Sign manufacturer to supply an Online Reorder Website for future orders by University. Online Website to show each sign type with sign type drawings and prices. Website must have sign parts and complete sign descriptions. Website to have password access by multiple users.

#### **1.3 SUBMITTALS**

- A. Submit in accordance with requirements of Division 1.
- B. Product Data: Submit product data for specified products. Include material details for each sign specified.
- C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.
- D. Samples: Submit supplier's standard color chart for selection purposes and selected colors for verification purposes.
- E. Installation: Submit supplier's installation instructions.
- F. Closeout Submittals:
  - 1. Submit operation and maintenance data for installed products, including precautions against harmful cleaning materials and methods.
  - 2. Submit warranty documents specified herein.

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

- A. Comply with requirements of Division 1.
  - 1. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
  - 2. Deliver products in manufacturer's original, unopened, undamaged containers

with identification labels intact.

3. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
4. Handle products in accordance with manufacturer's instructions.

## 1.5 WARRANTY

- A. Project Warranty: Comply with requirements of Division 1.
- B. Manufacturer's Warranty: Submit manufacturer's standard warranty document executed by authorized company official.
  1. Warranty Period: One (1) year from product ship date.

## 2 PRODUCTS

### 2.1 SIGNAGE SYSTEMS

- A. Acceptable Manufacturers:
  1. Basis of Design: ASI Signage Innovations, 520 Commerce Point, Harahan, LA 70123; (504) 704 1000 telephone; (504) 704 1006 facsimile. Emily Hebert Meyers (337) 517- 9451 Cell, Emily.Hebert@asisignage.com Email.
    - a) Acceptable Product: Horizon Arched Sign Face with Custom Graphics
  2. Prior Approved Equal: Best Sign Systems
    - a) Acceptable Product: Custom Strata Sign Systems
- B. Interior Wall-Mounted Restroom Signs – Sign Type A
  1. Arched face anodized aluminum frame size: 12" (height) x 8.78" (width)
  2. Accent Bar: ½" Red Anodized Aluminum Accent
  3. Plastic End Caps; color as selected by Architect from manufacturer's full range of colors.
  4. Inserts: ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  5. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text.
  6. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.
- C. Interior Wall-Mounted Exit Signs – Sign Type C
  1. Arched face anodized aluminum frame size: 6" (height) x 5.9" (width)
  2. Accent Bar: ½" Red Anodized Aluminum Accent
  3. Plastic End Caps; color as selected by Architect from manufacturer's full range of colors.
  4. Inserts: ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  5. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text.
  6. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.

- D. Interior Wall-Mounted Room Identity Sign with Paper Insert and ADA Footer Panel – Sign Type D
1. Arched face anodized aluminum frame size: 7" (height) x 8.7" (width)
  2. Accent Bar: ½" Red Anodized Aluminum Accent
  3. Clear Anodized Aluminum End Caps
  4. Inserts: 3"h ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  5. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text & Logo.
  6. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.
  7. 3 1/2"h Paperflex panel for updateable digitally printed Graphic Film or Paper Insert Window; Custom insert size; .020"thick Acrylic cover lens with matte finish
  8. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.
- E. Interior Wall-Mounted Stair Signs – Sign Type E
1. Arched face anodized aluminum frame size: 6" (height) x 5.9" (width)
  2. Accent Bar: ½" Red Anodized Aluminum Accent & Plastic End Caps
  3. Inserts: ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  4. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text.
  5. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.
- F. Interior Wall-Mounted Stairwell Signs – Sign Type E.1
1. ASIntouch III Series ADA Tactile & Braille Plaque
  2. Face Size: 18"h x 14"w x ¼" thick Painted Matte Clear Acrylic Panel
  3. Surface Texture: Smooth Texture with non glare finish.
  4. Raised text is integrally colored and 3D printed into face background.
  5. Text schedule: [Verify correct capitalization.]
  6. Corner Shape: Square
  7. Quantity: See schedule.
  8. Painted Satin Aluminum MX15 Color
  9. Wall Mounting: VHB tape and silicone.
- G. Interior Wall-Mounted Department Identity Signs with 8 1/2" x 11" Paper Insert Area - Sign Type F2
1. Arched face anodized aluminum frame size: 16-1/2" (height) x 8.7" (width)
  2. Accent Bar: ½" Red Anodized Aluminum Accent
  3. Plastic End Caps; color as selected by Architect from manufacturer's full range of colors.
  4. Inserts: 5"h ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.

5. Sign to have 11”h x .020”thick Clear Lens with Matte Finish. Paper Insert Included.
  6. Wall Mounting: Concealed mechanical mounting brackets through aluminum frame
- H. Interior Wall-Mounted Elevator Evacuation Signs – Sign Type G.
1. Arched face anodized aluminum frame size: 11” (height) x 8.78” (width)
  2. Accent Bar: ½” Red Anodized Aluminum Accent
  3. Plastic End Caps; color as selected by Architect from manufacturer’s full range of colors.
  4. Inserts: ASIntouch ADA insert. Material: Provide tactile copy and symbols raised 1/32 inch minimum from plaque first surface by manufacturer’s aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  5. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text.
  6. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.
- I. Interior Double-Sided Flag Mounted Signs – Sign Type L
1. Arched face anodized aluminum frame size (Two sided): Specify size: 12”h x 11.8”w
  2. Graphic insert size (Two sided): One arched aluminum graphic panel per sign side.
  3. Clear Anodized Aluminum Frame
  4. Clear Anodized Aluminum End Caps
  5. Accent Bar: ½” Red Anodized Aluminum Accent
  6. Sign to have .020”thick Clear Lens with Matte Finish. Subsurface Painted Satin Aluminum MX15 Color. 1<sup>st</sup> Surface Applied Vinyl Symbols.
  7. Projecting Mounting: Screw Mounted
- J. Interior Wall-Mounted Building Directory & Directional Sign – Sign Type N
1. Arched face anodized aluminum frame size: 31.5” (height) x 19.7” (width)
  2. Accent Bar: ½” Red Anodized Aluminum Accent
  3. (2) 3”w Clear Anodized Aluminum Panels.
  4. Clear Anodized Aluminum End Caps.
  5. Sign to have 5”h x .020”thick Clear Lens with Matte Finish. Subsurface Painted Satin Aluminum MX15 Color on 5”h Header. 2<sup>nd</sup> Surface ASIntouch III Series Flat Print Text.
  6. Sign to have 25”h x .020”thick Clear Lens with Matte Finish. Paper Insert Included.
  7. Wall Mounting: Concealed mechanical mounting brackets through aluminum frame
- K. Interior Wall-Mounted Elevator Evacuation Signs with Updateable Insert Area – Sign Type Q.
1. Arched face anodized aluminum frame size: 11.8” (height) x 11.8” (width)
  2. Accent Bar: ½” Red Anodized Aluminum Accent
  3. Clear Anodized Aluminum End Caps
  4. Inserts: 2-1/4”h ASIntouch ADA insert. Material: Provide tactile copy and Grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer’s aluminum backed photopolymer process. Sign face of single material (.040 aluminum backed photopolymer), tactile characters and Braille integral to photopolymer. Adhesive-fixed characters are not acceptable.
  5. Insert Painted Satin Aluminum MX15 Color with Silkscreened Text.
  6. 8 ½”h Paperflex panel for updateable digitally printed Graphic Film or Paper Insert Window; Custom insert size; .020”thick Acrylic cover lens with matte finish



7. Wall Mounting: VHB tape and silicone or mechanically fasten with bracket mounting.

## 2.2 SIGNAGE MATERIALS / COMPONENTS

- A. Materials and Components:
  1. Aluminum Frames: Extruded aluminum, AA 6063
  2. Anodize - Properties (Alubin, Milram) BS 1615
  3. Acrylic Covers / Properties  
(Palram) Excellent weather resistance and long stability against UV degradation
  4. PETG Covers / Properties  
(Palram) High impact resistance  
UV protective layer / weather resistant Face Components:
    - a) ADA-Ready Panels: .040" Aluminum-based photopolymer tactile and Braille characters with high temperature cured polyester color coating.
    - b) Graphic Panels: Thickness varies per application and material from .020" to .069".
2. Supports, Fixtures, and End Caps: As required for a complete and finished installation.
- B. Painted Surface Treatment Finish: Manufacturer's standard two-phase finishing process. Colors as selected from manufacturer's standard colors.
  1. Phase One: Priming with 2u depth layer for optimum surface coat adhesion and weatherability.
  2. Phase Two: Painting process employing two component, acrylic polyurethane coating of 20-30u depth.
- C. Powder Coated Finish:
  1. General: The standard powder coat finish consists of a Polyester or TGIC (Triglycidyl Isocyanurate) Polyester.
  2. Surface Preparation and Powder Coating: The exterior surface is cleaned in a minimum 5 stage wash system prior to the powder application. Then all exterior surfaces are coated with either a Polyester or TGIC (Triglycidyl Isocyanurate) Polyester powder. The powder coating is electrostatically applied to an average film thickness (DFT) of 3.0 mils (0.003") and then cured in a gas fired convection oven at a temperature range of 350° F - 400° F. The thermosetting powder resin provides both inner coat as well as substrate fusion adhesion.

## 2.3 FABRICATION – GENERAL

- A. General: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
- B. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
- C. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.
- D. Form panels to required size and shape. Comply with requirements indicated for design,

dimensions, finish, color, and details of construction.

- E. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.

### 3 EXECUTION

#### 3.1 EXAMINATION

- A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.
- B. Scheduling of installation by Owner or it's representative implies that substrate and conditions are prepared and ready for product installation. Proceeding with installation implies installer's acceptance of substrate and conditions.

#### 3.2 INSTALLATION

- A. Install product in accordance with supplier's instructions.
- B. Install product in locations indicated using mounting methods recommended by sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.
- C. Install product level, plumb, and at heights indicated.
- D. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.
- E. Install signs within the following tolerances and in accordance with manufacturer's recommendations:
  - 1. Interior Signs: Within 1/4 inch vertically and horizontally of intended location.

#### 3.3 CLEANING, PROTECTION, AND REPAIR

- A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 5 feet.
- B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project in accordance with provisions in Division 1.

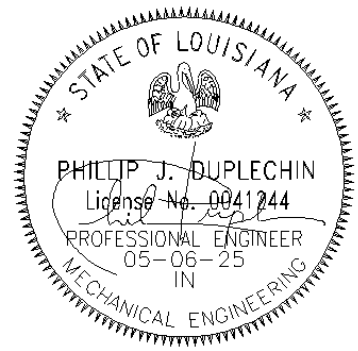
#### 3.4 SIGN SCHEDULE

- A. Schedule: Refer to signage schedule and Drawings for sizes, locations, and layout of signage types, sign text copy, and graphics.

END OF SECTION

## SECTION 23 00 00 - MECHANICAL GENERAL PROVISIONS

### PART 1 GENERAL



#### 1.01 SUMMARY

- A. The General Conditions of the Architectural Specifications, along with the supplementary conditions, special conditions, information to bidders, and any other pertinent information and documents shall apply the same as if repeated herein.

#### 1.02 SCOPE OF WORK

- A. Furnish all labor and material necessary to provide and install the complete mechanical portion of this Contract, including HVAC systems as called for herein and on accompanying drawings. Parts of the mechanical division may be bid separately or in combination, at the Contractor's option; however, it shall be the responsibility of the General Contractor to assure himself that all items covered in the this Division have been included if he chooses to accept separate bids.
- B. This Contractor shall refer to the Architectural and Structural drawings and install equipment, piping, etc. to meet building and space requirements. No equipment shall be bid on or submitted for approval if it will not fit in the space provided.
- C. It is the intention of these Specifications that all mechanical systems shall be furnished complete with all necessary valves, controls, insulation, piping, devices, equipment, etc. necessary to provide a satisfactory installation in working order.
- D. Contractor shall visit the site and acquaint himself thoroughly with all existing facilities and conditions that would affect his portion of the work. Failure to do so shall not relieve the Contractor from the responsibility of installing his work to meet the conditions.
- E. This Contractor shall protect the entire system and all parts thereof from injury throughout the project and up to acceptance of the work. Failure to do so shall be sufficient cause for the Architect to reject any piece of equipment.

#### 1.03 DEMOLITION

- A. The contractor shall visit the site prior to bid to determine the extent of work required to complete the project.
- B. Contractor shall coordinate demolition with owner. The Owner shall have "First Right of Refusal" regarding salvage of all equipment and materials to be removed. Locate equipment as directed by owner. All equipment and materials not salvaged by the owner shall be removed from the site and discarded at the contractor's expense.

- C. Contractor shall coordinate all work with general contractor and phase work as required by project.
- D. All equipment piping, etc. required to be removed to accommodate the modifications shall be removed.
- E. Contractor shall maintain services to existing facilities which shall remain during and after construction is complete.
- F. Contractor shall coordinate any shutdown of services with the owner. It is intended that the building will remain occupied during construction. Contractor shall schedule shut down of services with the owner in order to prevent disruption of building occupancy.
- G. Contractor shall be responsible for draining down of existing systems to complete demolition. All work shall be scheduled with the owner. Contractor shall also be responsible for refilling system and removing all air in order to return the systems to proper operating conditions.
- H. All shut down of services shall be done at night or during a time period approved by the owner. The systems shall be required to be back up and running each morning unless otherwise approved by the owner.

#### 1.04 GROUNDS AND CHASES

- A. This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of his work are properly built in as the work progresses; otherwise, he shall bear the cost of providing them.

#### 1.05 CUTTING AND PATCHING

- A. Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor being responsible for laying out and marking any and all holes required for the reception of his work. No structural beams or joists shall be cut or thimble without first receiving the approval of the Architect. After initial surfacing has been done, any further cutting, patching and painting shall be done at this Contractor's expense.

#### 1.06 FILL AND CHARGES FOR EQUIPMENT

- A. Fill and charge with materials or chemicals all those devices or equipment as required to comply with the manufacturer's guarantee or as required for proper operation of the equipment.

#### 1.07 MACHINERY GUARDS

- A. This Contractor shall provide v-belt guards for each v-belt drive or other hazardous drive. The guard shall enclose the drive entirely and shall have a hole for taking a tachometer reading.

- B. Provide protective guard for belts, pulleys, gears, couplings, projecting set screws, keys and other rotating parts which are located such that a person might come in close proximity. Construct protective guard around angle iron frame, securely bolted to apparatus; comply with safety requirements. Install guard to completely enclose drives and pulleys and not interfere with lubrication of equipment. Provide 2 inch minimum diameter opening in fan belt guards housing for tachometer.

#### 1.08 REPAIRING ROADWAYS AND WALKS

- A. Where this Contractor cuts or breaks roadways or walks, in order to lay piping, he shall repair or replace these sections to meet the Architect's approval.

#### 1.09 WELDING

- A. Weld piping and above grade steel tanks in accordance with qualified procedures using performance qualified welders and welding operators. Qualified procedures and welders in accordance with ASME Section IX. Welding procedures qualified by others and welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. Notify the A/E 24 hours in advance of tests, and perform the tests at the work site if practicable. Furnish A/E with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. Apply welders or welding operators assigned symbols near each weld they make as permanent record.

#### 1.10 NOISE AND VIBRATION

- A. Provide the plumbing system and its associated components, items, piping, and equipment free of objectionable vibration or noise. Statically and dynamically balance rotating equipment and mount or fasten so that no vibration is transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions at no additional compensation.

#### 1.11 PAINTING

- A. All painting shall be by the General Contractor's Painting Sub-Contractor. All pipe, pipe covering, equipment, supports, hangers, etc. exposed in the building or equipment room shall be painted. This Contractor shall prepare the surface of the material to receive the first coat of paint.
- B. All subsequent coatings shall be prepared by the Painting Sub-Contractor. Requirements covering paints, workmanship and preparation of surfaces as stated in the Architectural Specifications shall govern. Colors shall be approved by the Architect. All piping shall be color-coded.
- C. All piping shall be color coded per the following:
  - 1. Ductwork (Exposed in Building) Black

#### 1.12 CLEANING AND ADJUSTING

- A. Upon completion of his work, the Contractor shall clean and adjust all equipment, controls, valves, etc.; clean all piping, ductwork, etc.; and leave the entire installation in good working order.

#### 1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide the Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts lists, maintenance and repair instructions and test and balance report.
- B. COPIES OF SHOP DRAWINGS WILL NOT BE ACCEPTABLE AS OPERATION AND MAINTENANCE INSTRUCTIONS BUT MUST BE INCLUDED IN SUBMITTAL PACKAGE.
- C. This information shall be bound in plastic hardbound notebooks with the job name permanently embossed on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of equipment. Submit manuals to the Architect for approval.
- D. In addition to the operation and maintenance brochure, the Contractor shall provide a separate brochure which shall include registered warranty certificates on all equipment, especially any pieces of equipment which carry warranties exceeding one (1) year.
- E. The operation and maintenance brochure shall be furnished with a detailed list of all equipment furnished to the project, including the serial number and all pertinent nameplate data such as voltage, amperage draw, recommended fuse size, rpm, etc. The Contractor shall include this data on each piece of equipment furnished under this contract.

#### 1.14 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the project. This guarantee shall include furnishing of all labor and material necessary to make any repairs, adjustments or replacement of any equipment, parts, etc. necessary to restore the project to first class condition. This guarantee shall exclude only the changing or cleaning of filters. Warranties exceeding one (1) year are hereinafter specified with individual pieces of equipment.

#### 1.15 LOCAL CONDITIONS

- A. The location and elevation of all utility services is based on available surveys and utility maps and are reasonably accurate; however, these shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his satisfaction in order to determine the amount of work required for the execution of the Contract.

- B. The Contractor shall contact the various utility companies, determine the extent of their requirements and he shall include in his bid all lawful fees and payments required by these companies for complete connection and services to the building, including meters, connection charges, street patching, extensions from meters to main, etc.
- C. In case major changes are required, this fact, together with the reasons therefor, shall be submitted to the Architect, in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions and expenses necessary for the successful completion of the project.

#### 1.16 PERMITS, INSPECTIONS AND TESTS

- A. All permits, fees, etc. for the installation, inspections, plan review, service connections locations, and/or construction of the work which are required by any authority and/or agencies having jurisdiction, shall be obtained and paid for by the Contractor. This shall be verified during the bidding process.
- B. The Contractor shall make all tests required by the Architect, Engineer or other governing authorities at no additional cost to the Owner.
- C. The Contractor shall notify the Architect and local governing authorities before any tests are made, and the tests are not to be drawn off a line covered or insulated until examined and approved by the authorities. In event defects are found, these shall be corrected and the work shall be retested.
- D. Prior to requesting final inspection by the Architect, the Contractor shall have a complete coordination and adjustment meeting of all of his sub-contractors directly responsible for the operation of any portion of the system. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Architect in writing ten (10) days prior to this meeting, instructing him of the time, date and whom you are requesting to be present.
- E. This project shall not be accepted until the above provisions are met to the satisfaction of the Architect.

#### 1.17 CODES AND STANDARDS

- A. The entire mechanical work shall comply with the rules and regulations of the City, Parish, County and State in which this project is being constructed, including the State Fire Marshal and the State Board of Health. All modifications required by these authorities shall be made without additional charge to the Owners. The Mechanical Contractor shall report these changes to the Architect and secure his approval before work is started.
- B. In addition to the codes heretofore mentioned, all mechanical work and equipment shall conform to the applicable portions of the following specifications, codes and/or regulations:
  - 1. American Society of Heating, Refrigeration and
  - 2. Air Conditioning Engineers (ASHRAE)
  - 3. National Electrical Code (NEC)

4. National Fire Protection Association (NFPA)
  5. American Society of Mechanical Engineers (ASME)
  6. American Gas Association (AGA)
  7. International Building Code (IBC)
  8. International Mechanical Code (IMC)
  9. International Plumbing Code (IPC)
  10. International Fuel Gas Code (IFGC)
  11. Underwriters Laboratories (UL)
  12. Life Safety Code (NFPA 101)
  13. State Sanitary Code
  14. Louisiana State Uniform Construction Code Council (LSUCCC)
- C. All materials, equipment and accessories installed under this Contract shall conform to all rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment and accessories. All materials shall be new and of the best quality and first class in every respect. Whenever directed by the Architect, the Contractor shall submit a sample for approval before proceeding.
- D. Where laws or local regulations provide that certain accessories such as gauges, thermometers, relief valves and parts be installed on equipment, it shall be understood that such equipment be furnished complete with the necessary accessories, whether or not called for in these Specifications.
- E. All unfired pressure vessels shall be built in accordance with the A.S.M.E. Code and so stamped. Furnish shop certificates for each vessel.

#### 1.18 REVIEW OF MATERIALS

- A. Whenever manufacturers or trade names are mentioned in these Plans or Specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only, and should not be construed to infer a preference. Equivalent products which meet the Architect's approval will be accepted; however, these products must be submitted to the Architect a minimum of seven (7) days prior to the Bid Date.
- B. Submission shall include the manufacturer's name, model number, rating table and construction features.
- C. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. THE CONTRACTOR SHALL BASE HIS BID SOLELY ON THOSE ITEMS SPECIFIED OR INCLUDED IN THE "PRIOR APPROVAL ADDENDUM", AS NO OTHER ITEM WILL BE ACCEPTABLE.
- D. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with the Plans and Specifications and that it will fit into the space provided. Shop drawings must be submitted on all items of equipment for approval as hereinafter specified.



- E. Before proceeding with work and/or within thirty (30) days after the award of the General Contract for this work, the Mechanical Contractor shall furnish to the Architect complete shop and working drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this project. These drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.
- F. The Architect's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other errors which may be contained in these drawings. Any omission from the shop drawings or specifications, even though approved by the Architect, shall not relieve the Contractor from furnishing and erecting same.
- G. If contractor submits hard copies, Six (6) sets of shop drawings shall be submitted to the Architect for approval. These submittals shall be supplied as part of this Contractor's contract.
- H. This information shall be bound in plastic hardbound notebooks with the job name on the cover. Rigid board dividers with labeled tabs shall be provided for different pieces of materials and equipment. Submit shop drawings to the Architect for approval. Faxed copies shall not be acceptable. We prefer electronic submissions sent via E-Mail.
- I. Required shop drawing submittals shall include but are not limited to the following:
  - 1. VRF Air Conditioning Equipment.
  - 2. Packaged Air Conditioning Equipment.
  - 3. Grilles, registers, diffusers and louvers.
  - 4. Ductwork and duct sealer.
  - 5. Duct insulation and accessories.
  - 6. Controls/Building Automation System.
  - 7. Exhaust fans.
  - 8. Unit heaters.
  - 9. Double wall spiral pipe and fittings.
  - 10. Relief and intake hoods.
  - 11. Fire dampers
  - 12. Smoke dampers.
  - 13. Combination Fire and Smoke Dampers
  - 14. Manual Dampers, Motorized Dampers and Control Dampers.
  - 15. Actuators.
  - 16. Test and Balancing Agency (including forms).

#### 1.19 COORDINATION DRAWINGS

- A. Submit three (3) black line prints of all mechanical room layouts showing locations of all equipment, piping, etc. to insure all will fit in space provided. Submit drawings at 1/4" scale. Layouts shall include equipment submitted on project to scale on plans.
- B. Submit coordination drawings with the respective equipment shop drawings.

## 1.20 MINOR DEVIATIONS

- A. Plans and detail sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes and manner of erecting work. Structural or other conditions may require certain modifications from the manner of installation shown, and such deviations are permissible and shall be made as required. However, specified sizes and requirements necessary for satisfactory operation shall remain unchanged. It may be necessary to shift ducts or pipes, or to change the shape of ducts, and these changes shall be made as required. All such changes shall be referred to the Architect and Engineer for approval before proceeding. Extra charges shall not be allowed for these changes. The contractor shall obtain a full set of plans and specifications for the coordination of his work prior to bidding this project. Items which are unclear to the bidding contractor shall be brought to the Architect and Engineers attention prior to bidding the project. An interpretation shall be clarified by the Architect and/or the Engineer prior to bidding.
- B. The Contractor shall realize that the drawings could delve into every step, sequence or operation necessary for the completion of the project, without drawing on the Contractor's experience or ingenuity. However, only typical details are shown on the Plans. In cases where the Contractor is not certain about the method of installation of his work, he shall ask for details. Lack of details will not be an excuse for improper installation.
- C. In general, the drawings are diagrammatic and the Contractor shall install his work in a manner so that interferences between the various trades are avoided. In cases where interferences do occur, the Architect is to state which item was first installed.

## 1.21 AS-BUILT RECORD DRAWINGS

- A. The Contractor shall obtain at his cost, two sets of blackline prints of the original bid documents by the Architect. One set shall be kept on the site with all information as referenced below, and shall update same as the work progresses. The other set will be utilized to record all field changes to a permanent record copy for the Owner.
- B. If the Contractor elects to vary from the Contract Documents and secures prior approval from the Architect for any phase of the work, he shall record in a neat and readable manner, ALL such variances on the blackline print in red. The original blackline prints shall be returned to the Architect for documentation.
- C. All deviations from sizes, locations, and from all other features of the installations shown in the Contract Documents shall be recorded.
- D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions and the like, as well as other features of the work which will be concealed underground and/or in the finished building.
- E. Locations of underground work shall be established by dimensions to columns, lines or walls, locating all turns, etc., and by properly referenced centerline or invert elevations and rates of fall.

- F. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases this may be by dimension. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. The Architect's/Engineer's decision in this matter will be final.
- G. The following requirements apply to all "As-Built" drawings:
  - 1. They shall be maintained at the Contractor's expense.
  - 2. All such drawings shall be done carefully and neatly, and in a form approved by the Architect/Engineer.
  - 3. Additional drawings shall be provided as necessary for clarifications.
  - 4. These drawings shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by the Architect/Engineer; and when necessary, to establish clearances for other parts of the work.
  - 5. "As-built" drawings shall be returned to the Architect upon completion of the work and are subject to approval of the Architect/Engineer.

## PART 2 PRODUCTS

### 2.01 HVAC SYSTEM PRODUCTS

- A. Refer to individual Division 23 sections for mechanical products, controls, fans, pipe, tube and fitting materials and joining methods.

## PART 3 EXECUTION

### 3.01 MANUFACTURER'S DIRECTION

- A. The contractor shall install and operate all equipment and material in accordance with the manufacturer's installation and operating instructions. The manufacturer's instructions of installation and operation shall become part of the Contract Documents and shall supplement the Drawings and Specifications.

### 3.02 EQUIPMENT LABELS

- A. Provide equipment labels for HVAC Equipment. Labels shall have permanent laminated construction secured to equipment.
- B. Provide laminated plate for each VRF unit. For Ducted units above ceiling and refrigerant controllers (BC/BS)- Attach plate to ceiling grid to indicate location above ceiling. Plates shall be white with black letters. For ceiling recessed units – Attached plate within the filter compartment. Tag shall not interfere with the filter installation. Coordinate color selection with owner.

### 3.03 PIPE LABELS

- A. Provide pipe markers and directional arrows on all piping in mechanical equipment rooms, or which is exposed in building, and on both sides of all valves located above ceiling. Markers

shall be as manufactured by W.H. Bradley Co., Marking Services Inc. or the equivalent. All letters shall be color-coded and sized as recommended by OSHA. Samples of the type of letters to be used shall be submitted with shop drawings. Piping shall be color-coded.

- B. Pipe markers with arrows shall indicate lines content and shall be located 20 feet on center and at each change of direction of line. Identification bands shall be color coded to match pipe markers and shall be provided 10 feet on center. Pipe identification markers shall be taped at each end and shall be taped around the entire circumference of pipe.
- C. The following Piping shall be identified:
  - 1. Refrigerant Lines
  - 2. Condensate Drain

#### 3.04 ACCESS DOORS:

- A. Provide access doors in walls, floors and ceilings to permit access to equipment and piping requiring service or adjustment.
  - 1. Valves.
  - 2. Manual balancing dampers and automatic control dampers.
  - 3. Air terminal units and VRF indoor units.
  - 4. Duct mounted filters and coils.
  - 5. Drainage cleanouts.
  - 6. Kitchen Hood exhaust ductwork in accordance with NFPA requirements.
  - 7. Equipment shutoff protection devices such as disconnects, motor rated switches, etc.
  - 8. Other mechanical equipment indicated in schedules or specifications which are requiring maintenance, adjustment or operation.
- B. Provide hinged access doors and frames as follows:
  - 1. Drywall Construction:
    - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel.
    - b. Provide prime paintable surface (not galvanized).
    - c. Product: Milcor "Style M" or Karp DSC-214M.

2. Visible Masonry and Ceramic Tile:
    - a. Milcor “Style M” or Karp DSC-214M.
  3. Cement Plaster:
    - a. Milcor “Style K” or Karp DSC-214 PL.
  4. Acoustical Plaster:
    - a. Reinforced panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sufficient number for the size of the panel. Provide factory prime paint surface (not galvanized).
    - b. Product: Milcor “Style AP” or Karp 214 PL.
  5. Acoustical Tile:
    - a. Milcor “Style AT” or Larsen L-CPA.
- C. Provide continuous concealed hinges and cam locks.
- D. Provide UL listed 1-1/2 hour label “B” access doors with automatic self-closing latching mechanism where required.
- E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.
- F. Coordinate approval of type, color and location of access doors & frames with Architect.

### 3.05 CLEANING AND SERVICE

- A. Upon Completion of this work, the contractor shall clean and adjust equipment, controls, valves, etc.;
- B. Inspect, clean and service air filters and strainers immediately prior to final acceptance of project.
- C. Provide complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced condition, check the charge and modify it for proper operation as required.
- D. Place mechanical systems in complete working order. Clean equipment and piping materials thoroughly returning to “as new” condition prior to request for substantial completion.
- E. Remove excess materials and debris from mechanical rooms and drain pans. Broom clean areas. Thoroughly clean ductwork inside and outside before air devices (diffusers, grilles, etc.) are installed.

### 3.06 TEMPORARY HEATING AND AIR CONDITIONING DURING CONSTRUCTION PHASE

- A. Permanent building air conditioning equipment or systems are not designed to control building temperature and humidity levels during construction of the building. The building's HVAC system is not designed nor is it well suited for the proper drying of building/construction materials, and should not be used for such purposes.
- B. At all times, during construction phases, provide temporary ventilation both for comfort and protection of workers, for proper drying of wet work, and for proper curing of installed materials. Follow material manufacturer's published instructions with regard to installation of building materials.
- C. Provide temporary heat both for the comfort and protection of workers and as necessary to ensure suitable working conditions for construction operations of construction trades, and also as necessary for storage of products and materials. Refer to material manufacturer's literature for environmental operational temperature and humidity requirements.
- D. Provide temporary heat by use of self-contained, vented portable heating units, employing tanked gas or other approved heat source.
- E. Use only heating apparatus and fuels labeled or listed by a "National Recognized Testing Laboratory" recognized by OSHA. Keep equipment and surroundings in clean, safe conditions.
- F. Use flame resistant tarpaulins other material for temporary enclosures of space.
- G. Provide temporary humidity control by the use of small incremental de-humidifiers, packaged desiccant type de-humidifiers, and/or packaged DX type air conditioners.
- H. Do not permit space temperatures to reach or fall to a level which will cause damage to work. Coordinate the temperature and humidity requirements with the manufacturer of the finishes being provided.
- I. Replace interior or exterior surfaces damaged by the use of temporary heaters with new materials or refinish at no additional expense to the owner.
- J. As soon as practical after permanent heating, ventilation, and air conditioning systems are in place and operable, the contractor at his option, may provide heat from the permanent building heating system, until such time that the building is complete. It is recommended that the building's permanent heating and air conditioning systems not be utilized to maintain temperature and humidity conditions within the building during the construction phase. Small space heaters and portable de-humidifiers are suggested as sources of temperature and humidity control. It is the intent that the permanent HVAC systems should not be used to condition or control humidity during construction.
- K. The use of permanent HVAC systems will require that the systems be complete and fully controllable by the Building Automation System (BAS) including the ability to remotely alarm proper maintenance personnel in the event of any and all system failure(s) or inability to maintain setpoint temperatures and humidity levels. Should the contractor elect to utilize the building's permanent HVAC system, the contractor shall bring the HVAC systems and

ductwork back to an original unused condition or state by thoroughly cleaning and/or repairing both equipment and ductwork including repair and refinishing scrapes, tears, scratches and dents, cleaning ductwork, cleaning AHU coils, etc.

- L. All dust, dirt, fungal growth, and debris in duct work shall be cleaned.
- M. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.
- N. Contractor's Use of Permanent HVAC Systems:
  - 1. Heating System:
    - a. Should the contractor (at his option and at his own risk), utilize the building's permanent heating systems provided under this contract to provide space heating prior to project completion date subject to the restraints stated herein.
    - b. The fuel for such space heating and for required tests of heating equipment shall be provided by contractor.
    - c. The start up of equipment for use by the contractor shall not commence any warranty period.
    - d. The heating system shall be operated only by qualified personnel, and shall be operated with all auxiliaries, safeties, and in accordance with manufacturer's instructions and good operating practice.
    - e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, contractor will be directed to disconnect its use.
    - f. Heating systems shall be operated and controlled to prevent temperature in any room or space in any building from exceeding 90 deg. F.
    - g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork piping, etc., shall not either fall or be elevated above or below normal operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.
    - h. Systems shall not be operated unattended such as on holidays, weekends, nights, etc, nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to "monitor or attend to" the systems such as security personnel, or janitorial staff. The heating system, when in operation, shall be continuously monitored by the mechanical contractor's approved personnel.

- i. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air ductwork from accumulating dust or otherwise becoming dirty.
  - j. Prior to final acceptance of the work, the contractor shall place heating systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.
  - k. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.
- 2. Preliminary Heating Test, Adjusting and Balancing Report:
  - a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:
    - 1) Air pressure drop across the unit filters
    - 2) Air pressure drop across the unit's cooling coil(s)
    - 3) Air pressure drop across the unit's heating coil(s)
    - 4) Total static pressure produced by the unit
    - 5) Discharge air static pressure
    - 6) Fan RPM
    - 7) Suction air pressure
    - 8) Provide a unit pressure graph
    - 9) Discharge air temperature (each air moving device)
    - 10) Return air temperature (each air moving device)
    - 11) Entering water temperatures (hot & chilled)
    - 12) Leaving water temperatures (hot & chilled)
    - 13) Water flow quantity (gpm) through the coil(s)(hot & chilled)
- 3. Air Conditioning System:
  - a. Should the contractor (at his option and at his own risk), utilize the building's permanent air conditioning systems provided under this contract to provide space cooling and de-humidification prior to the project completion date. As such, any damages, loss of performance, wear, and other detrimental effects caused by the operational performance characteristics of the A/C system such as condensation, sweating of grilles, registers, diffusers, ducts, equipment, walls, floors, ceilings, and other conditions which may cause damage to building components or which cause mold, mildew, etc., shall be the total responsibility of the contractor.
  - b. The fuel, electricity or other energy required for space cooling and for any subsequent operation or testing shall be provided by the Contractor.



- c. The cooling system(s) shall be operated only by fulling qualified personnel and shall be operated with all safety auxiliaries, and in accordance with manufacturer's instructions and good operating practice.
- d. Start-up of equipment for use by the Contractor shall not commence any warranty period.
- e. If at any time the Owner's Representative determines that the equipment is being improperly operated or maintained, the contractor will be directed to discontinue and disconnect its use and the contractor will be required to provide portable units to maintain space temperatures.
- f. Temporary cooling and/or de-humidification systems shall be operated and controlled to prevent temperature and humidity in any room or space in any portion of the building from falling below 75 deg. F or above 65% relative humidity.
- g. Temperature controls shall be functional to the extent that the operating temperatures of equipment, ductwork, piping, etc., shall not fall below the normal stated "design" operating limits. The contractor shall demonstrate to the owner or his representative the ability of the system to be controlled, including limit alarms installed and the ability to monitor the systems off-site.
- h. Insulation systems for all piping, ductwork, etc., shall be completely installed prior to use of the permanent systems.
- i. Systems shall not be operated unattended such as on holidays, weekends, nights, etc., nor shall personnel unfamiliar with the operation of the HVAC Systems be employed to "monitor or attend to" the systems such as security personnel, or janitorial staff. The air conditioning system when in operation, shall be continuously monitored by the mechanical contractor's approved personnel.
- j. Systems when activated, may be placed into operation without diffusers and registers in place, but filters capable of filtering gypsum dust or other associated construction dust and debris shall be provided both in air handling equipment and at return air grille locations. Filter all return air entering duct work, to prevent return air duct work from accumulating dust or otherwise becoming dirty.
- k. Contractor shall, prior to final acceptance of the work, place cooling systems and related equipment in a condition equal to new in that contractor shall clean all ductwork, coils, equipment, etc.
- l. All disposable or wearable parts such as belts, filters, etc., shall be replaced without option or cause.

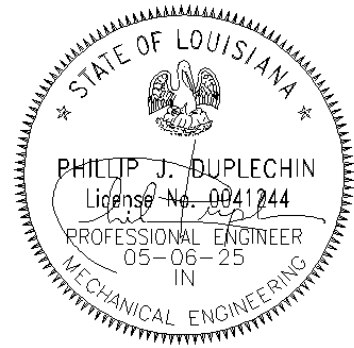
4. Preliminary Air Conditioning Test, Adjusting and Balancing Report:

a. Provide a TAB report at the time the heating system(s) start-up which shall indicate the following conditions:

- 1) Air pressure drop across the unit filters
- 2) Air pressure drop across the unit's cooling coil(s)
- 3) Air pressure drop across the unit's heating coil(s)
- 4) Total static pressure produced by the unit
- 5) Discharge air static pressure
- 6) Fan RPM
- 7) Suction air pressure
- 8) Provide a unit pressure graph
- 9) Discharge air temperature (each air moving device)
- 10) Return air temperature (each air moving device)
- 11) Entering water temperatures (hot & chilled)
- 12) Leaving water temperatures (hot & chilled)
- 13) Water flow quantity (gpm) through the coil(s)(hot & chilled)

END OF SECTION 23 00 00

## **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT**



### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section 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. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.

- 3. Capacitor start, inductor run.
- 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

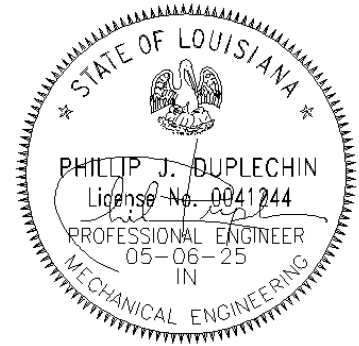
- A. All materials and equipment shall be installed in accordance with Manufacturer's recommended installation methods for obtaining conformance with the Contract Documents.
- B. Alignment of all motors, factory coupled or mounted, and all motors field coupled and mounted, shall be rechecked after all connections have been made and after 48 hours of operation in designed service.
- C. Verify the voltage characteristics of each motor prior to ordering.
- D. Verify the correct wire connections and rotation of equipment by "bumping" motor after wiring.
- E. Confirm voltage imbalance on 3-phase motors is less than 2%.

#### 3.2 APPLICATION: Except as specifically indicated, motors shall be selected as follows:

- A. Phase:
  - 1. Less than 1.0 HP: Single-Phase.
  - 2. 1 HP and Larger: Three-phase.
- B. Single Phase Starting:
  - 1. 1/8 HP and Less: Split phase or permanent split capacitor.
  - 2. Greater than 1/8 HP: Capacitor start.
- C. Enclosure:
  - 1. Totally enclosed fan-cooled (TEFC) for all motors located outside above roof, in wet areas, in mechanical rooms, or elsewhere as indicated.
  - 2. Open drip-proof (ODP) for motors located elsewhere, in a clean, dry environment.

END OF SECTION 23 05 13

## SECTION 23 05 29 - 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. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.5 ACTION SUBMITTALS

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

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.7 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.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  - 1.
  - 2. Manufacturers:
    - a. Cooper B-Line, Inc.; a division of Cooper Industries.
    - b. Flex-Strut Inc.
    - c. Thomas & Betts Corporation, A Member of the ABB Group.
    - d. Unistrut; an Atkore International company.
    - e. Wesanco, Inc.
  - 3. Standard: MFMA-4.
  - 4. Channels: Continuous slotted steel channel with intumed 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.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
- B. Roof Sleepers for VRF outdoor condensing units: Pate Model ES-2 or equal, equipment rail supports, 18 ga. Galvanized steel, unitized construction with integral base plate, continuous welded corner seams, pressure treated wood nailer, counterflashing with screws. Height of support shall be a minimum of 16 inches. Coordinate layout of supports with the equipment manufacturer's representative and equipment point loading requirements. Coordinate flashing and exterior insulation with the roofing installer and Architect.

## 2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe



hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. 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.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-

distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- E. Use thermal-hanger shield inserts for insulated piping and tubing.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of 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.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams,

channels, or angles.

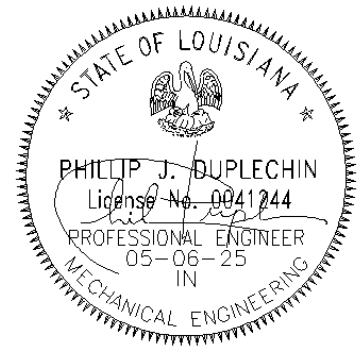
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to 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.
- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

END OF SECTION 23 05 29

## SECTION 23 05 53 - IDENTIFICATION 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. Equipment Labels.
  - 2. Chilled Water Piping Labels (Exterior)

#### 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.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Manufacturer shall be one of the following:
    - a. Brady Corporation.
    - b. Brimar Industries, Inc.
    - c. Carlton Industries, LP.
    - d. Champion America.
    - e. Craftmark Pipe Markers.
    - f. Emedco.
    - g. Kolbi Pipe Marker Co.
    - h. LEM Products Inc.
    - i. Marking Services, Inc.
    - j. Seton Identification Products.
  - 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
  - 3. Letter Color: White.
  - 4. Background Color: Black.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  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.
  9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules).
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulated.

### 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

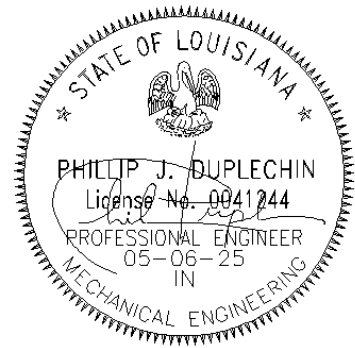
- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

END OF SECTION 23 05 53



## SECTION 23 05 93 - 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 SCOPE OF WORK

- A. The Contractor shall obtain the services of an independent Test and Balance (TAB) Company which specializes in the testing and balancing of heating, ventilating and air conditioning (HVAC) systems to test, adjust and balance all HVAC systems in the building(s).
- B. The work included in this section consists of furnishing labor, instruments, and tools required in testing, adjusting and balancing the HVAC systems as described in these specifications or shown on accompanying drawings. Services shall include checking equipment performance, taking the specified measurements, and recording and reporting the results. The testing, adjusting and balancing agency shall act as a reporting agency; that is, list and report each piece of equipment as to identification number, manufacturer, model number, serial number, proper location, specified performance, and report actual performance of all equipment as found during testing. The report is intended to be used during the life of the building as a ready reference indicating original conditions, equipment components, etc.
- C. Representatives of the Test and Balance Company shall visit the job site during installation of the HVAC equipment, piping and ductwork as required.
- D. Upon completion of the HVAC system installation, the Test and Balance Company shall perform all required testing and balancing with the full cooperation of the Contractor and his Sub-contractors. The Contractor shall make changes and/or adjustments to the HVAC system components that are required by the Test and Balance Company to accomplish proper balancing. The TAB agency shall not supply or install any materials or balancing devices such as pulleys, drives, belts, etc. All of this work is by the Contractor and shall be performed at no additional cost to the Owner.
- E. The test and balance report complete with a summary page listing all deficiencies shall be submitted to the Architect for review. If the Architect agrees with the report, he shall sign it and return it to the Contractor. The test and balance report must be complete and must be accepted by the Architect prior to acceptance of the project. Any outstanding test and balance items shall be placed on the punch list and a monetary value shall be assigned to them.
- F. After all deficiencies have been corrected the Architect shall sign the testing and balancing report, and the Test and Balance Company shall supply four (4) copies of the final and complete report to the Contractor for inclusion in the Operation and Maintenance Manuals.
- G. The Test and Balance Company shall obtain a copy of all HVAC related shop drawings from the contractor. The contractor shall provide a set of approved shop drawings to the TAB contractor within 30 days from receiving approved shop drawings.

- H. The items requiring testing, adjusting, and balancing include (but are not restricted to) the following:
  - 1. Air Systems:
    - a. Supply Fan Packaged A/C unit
    - b. Zone Branch and main ducts
    - c. Diffusers, Registers, Grilles and Dampers
    - d. Coils (Air Temperatures)
  - 2. Duct leakage tests.

### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building automation systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, adjusting, and balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Certified TAB reports.
- B. Sample report forms.

### 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for 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 applicable for intended purpose and 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 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." Compare 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 verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine operating safety interlocks and controls on HVAC equipment.

- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" 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.
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish.
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. 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.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified.

### 3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
  2. Adjust submain and branch duct volume dampers for specified airflow.
  3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
  2. Measure inlets and outlets airflow.
  3. Adjust each inlet and outlet for specified airflow.
  4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
  2. Re-measure and confirm that total airflow is within design.
  3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
  4. Mark all final settings.
  5. Test system in economizer mode. Verify proper operation and adjust if necessary.
  6. Measure and record all operating data.
  7. Record final fan-performance data.

### 3.6 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Phase and hertz.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter size and thermal-protection-element rating.
  8. Service factor and frame size.

### 3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

### 3.8 DUCT LEAKAGE TESTS

- A. Witness the duct pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified tolerances.
- C. Report deficiencies observed.
- D. Ductwork that initially fails these tests shall be replaced, modified, resealed, etc. as required to meet the leakage requirement and then re-test to ensure compliance.

### 3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Equipment with Fans: Plus or minus 10 percent.
  - 2. Exhaust Fans: Plus 10 percent.
  - 3. Outside Airflow: Plus 10 percent.
  - 4. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.10 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 engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- 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 specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Notes to explain why certain final data in the body of reports vary from indicated values.
  14. Test conditions for fans 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. Fan drive settings including settings and percentage of maximum pitch diameter.
    - e. Settings for supply-air, static-pressure controller.
    - f. Other system operating conditions that affect performance.
- D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total airflow rate in cfm.
    - b. Total system static pressure in inches wg.
    - c. Fan rpm.
    - d. Discharge static pressure in inches wg.
    - e. Filter static-pressure differential in inches wg.
    - f. Preheat-coil static-pressure differential in inches wg.
    - g. Cooling-coil static-pressure differential in inches wg.
    - h. Heating-coil static-pressure differential in inches wg.
    - i. Outdoor airflow in cfm.
    - j. Return airflow in cfm.
    - k. Outdoor-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.
- 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, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
  - a. System and air-handling-unit number.
  - b. Location and zone.
  - c. Traverse air temperature in deg F.
  - d. Duct static pressure in inches wg.
  - e. Duct size in inches.
  - f. Duct area in sq. ft.
  - g. Indicated airflow rate in cfm.
  - h. Indicated velocity in fpm.
  - i. Actual airflow rate in cfm.
  - j. Actual average velocity in fpm.
  - k. Barometric pressure in psig.

G. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

### 3.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect.

- B. Architect may 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.
- C. 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."
- D. 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.
- E. If TAB work fails, proceed as follows:
  - 1. TAB specialists shall 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 specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.
  - 3. If the second verification also fails, the design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

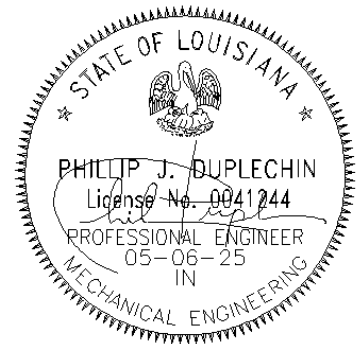
### 3.12 ADDITIONAL TESTS

- 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 05 93

## SECTION 23 07 13 - 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. Indoor, concealed supply, return, exhaust and outdoor air.
  - 2. Indoor, exposed supply, return, exhaust and outdoor air.
  - 3. Tops of supply air diffusers, grilles and plenum boxes.
  - 4. Outdoor, supply and return air.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance, thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities

having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields as specified.
- 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.

#### 1.8 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," articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing

process.

- F. Fire Rated Insulation:
  - 1. Manufacturer shall be one of the following:
    - a. 3M FireMaster Fast Wrap 615+.
    - b. Thermal Ceramics FireMaster.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
  - 1. Manufacturer shall be one of the following:
    - a. Aeroflex, USA, Inc.
    - b. Armacell LLC.
- H. Fiber-Glass Blanket Insulation: Fiber-Glass bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Manufacturer shall be one of the following:
  - 2.
    - a. Certainteed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Manufacturer shall be one of the following:
    - a. Aeroflex USA, Inc.
    - b. Armacell LLC.
    - c. Foster Brand.
- C. Fiber-Glass Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Manufacturer shall be one of the following:
    - a. Childers Brand.
    - b. Eagle Bridges – Marathon Industries.
    - c. Foster Brand.
    - d. Mon-Eco Industries, Inc.

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
  - 1. Manufacturer:

- a. Foster Brand.
  - b. Knauf Insulation.
  - c. Vimasco Corporation.
  - d. Childers.
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

## 2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
  5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## 2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

## 2.6 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.7 SECUREMENTS

- A. Bands:
  1. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
    - d. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - e. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - f. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

## 2.8 WALL LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers shall be as follows:
    - a. Certainteed
    - b. Owens Corning
    - c. Johns Manville
    - d. Knauf
  2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully

- annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

### 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 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies.

### 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.6 INSTALLATION OF FIBER-GLASS 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.

### 3.7 WALL LINER

#### A. Apply on all mechanical room walls from floor to ceiling / deck.

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners or cut and fit to ensure butted-edge overlapping.
5. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

#### A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

### 3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

### 3.10 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified.
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.12 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply air.
  - 2. Indoor, concealed return air.
  - 3. Indoor, concealed exhaust air.
  - 4. Indoor, concealed outdoor air.
  - 5. Indoor, return air plenum boxes.
  - 6. Indoor, tops of ceiling diffusers and grilles.
  - 7. Indoor, exposed supply air.

8. Indoor, exposed return air.
9. Indoor, exposed exhaust air.
10. Indoor, exposed outdoor air.
11. Outdoor, supply air.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

### 3.13 DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

B. Concealed, round and flat-oval, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

D. Concealed, round and flat-oval, exhaust-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

E. Concealed, rectangular, supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

F. Concealed, rectangular, return-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

G. Concealed, rectangular, outdoor-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be the following:

1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
2. Minimum installed R-value shall be R-6.0.

I. Concealed, supply-air plenum insulation shall be the following:

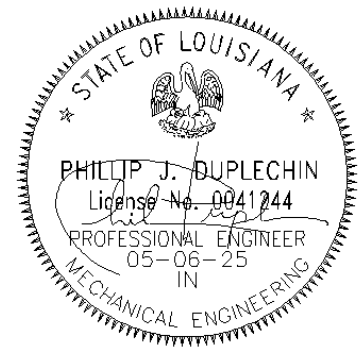
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.

2. Minimum installed R-value shall be R-6.0.
- J. Return air plenum boxes installation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
- K. Tops of supply air diffusers and grilles insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
  - 3.
- L. Exposed, rectangular, supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
- M. Exposed, rectangular, return-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
- N. Exposed, supply-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
- O. Exposed, return-air plenum insulation shall be the following:
1. Mineral-Fiber Blanket: 2.125 inches thick and 0.75-lb/cu. ft. nominal density.
  2. Minimum installed R-value shall be R-6.0.
- P. Outdoor (exposed to weather), outside air supply ductwork shall be the following:
1. Elastomeric Insulation: 2 inch thick flexible blanket.
  2. Install jacket over insulation material with Stainless Steel, Type 304 or Type 316, sheet metal with 0.024 inch thickness.
  3. In lieu of the stainless steel jacket, at contractor's option, the contractor may provide a pre-finished 16 gauge paint grip sheet metal to cover entire duct system insulation. Final color to be selected by architect.

END OF SECTION 23 07 13

## SECTION 23 07 19 - HVAC PIPING 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 HVAC piping systems:
  - 1. Condensate drain piping, indoors and outdoors.
  - 2. Refrigerant suction and hot-gas piping, indoors and outdoors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.5 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 and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing 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.

#### 1.6 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.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified.
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," and "Outdoor, Aboveground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.



- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Manufacturer shall be one of the following:
    - a. Armacell AP.
    - b. Aeroflex USA.
    - c. K-Flex USA.

## 2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
  - 1. Manufacturers shall be one of the following:
    - a. Childers Brand.
    - b. Eagle Bridges – Marathon Industries.
    - c. Foster Brand.
  - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
  - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  - 5. Color: White.

## 2.4 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Finish and thickness are indicated in field-applied jacket schedules.
    - b. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
    - c. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

- 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
2. At contractor's option, in lieu of 0.016 aluminum jacket, the contractor may use Venture Clad 1577CW multi-layered laminate coated, acrylic pressure sensitive adhesive jacket system.

### 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.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies.

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Closed Cell Elastomeric: 3/4 inch thick.
- B. Refrigerant Suction and Hot-Gas Piping: (IF APPLICABLE)
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Closed Cell Elastomeric: 3/4 inch thick.

### 3.10 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: (IF APPLICABLE)
  - 1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Closed Cell Elastomeric: 1 inches thick.

### 3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

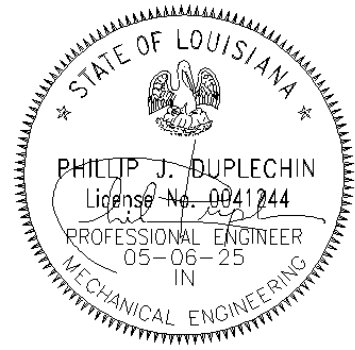
- A. Install jacket over insulation material.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Refrigerant Piping,: For refrigerant lines exposed to weather, in crawl spaces, exposed in building and above ceiling from the outdoor unit to the branch controller. Each individual pipe shall be covered independent of the next pipe. Multiple pipes within the same cover is **NOT** acceptable.
  - 1. Venture Clad 1577CW.
- D. Refrigerant Piping, For refrigerant lines exposed in building. Each individual pipe shall be covered independent of the next pipe. Multiple pipes within the same cover is **NOT** acceptable.
  - 1. Venture Clad 1577CW.

### 3.12 OUTDOOR, FIELD-APPLIED MASTIC SCHEDULE

- A. Install two layers of mastic over insulation material.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Condensate Piping, Concealed:
  - 1. None.
- D. Condensate Piping, Exposed:
  - 1. Vapor-Barrier Mastic: Solvent based.

END OF SECTION 23 07 19

## SECTION 23 21 14 - HVAC CONDENSATE PIPING



### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
  - 1. Condensate-drain piping.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Copper Tube.
  - 2. Plastic pipe and fittings with solvent cement.
- B. Delegated-Design Submittal:
  - 1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
  - 2. Locations of pipe anchors and alignment guides and expansion joints and loops.
  - 3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
  - 4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
  - 1. Condensate-Drain Piping: 140 deg F.

#### 2.2 COPPER TUBE AND FITTINGS

- A. DWV Copper Tubing: ASTM B 306, Type DWV.

## 2.3 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D 1785, with wall thickness as indicated in "Piping Applications" Article.
  - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

## 2.4 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- D. Solvent Cements for Joining Plastic Piping:
  - 1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
    - a. PVC solvent cement shall have a VOC content of 510 g/L or less.
    - b. Adhesive primer shall have a VOC content of 550 g/L or less.
    - c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

## 2.5 TRANSITION FITTINGS

- A. Plastic-to-Metal Transition Fittings:
  - 1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.
- B. Plastic-to-Metal Transition Unions:
  - 1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating



nonconductive insulating material. Include end connections compatible with pipes to be joined.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Exterior Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- B. Interior Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

#### 3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- M. Install shutoff valve immediately upstream of each dielectric fitting.
- N. Comply with requirements specified for identifying piping.

#### 3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

### 3.4 HANGERS AND SUPPORTS

- A. Comply with requirements specified for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- C. Install hangers for copper piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  - 6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- D. Plastic Piping Hanger Spacing: Space hangers shall be according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

### 3.5 PIPE JOINT CONSTRUCTION

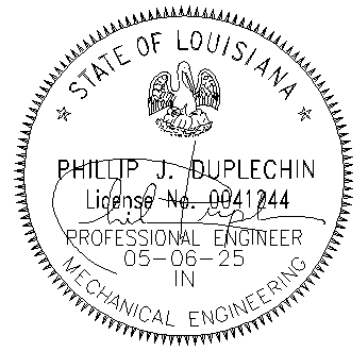
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- D. 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/A5.8M.
- E. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join ASTM D 1785 schedule number, 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.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

END OF SECTION 23 21 14

## SECTION 23 31 13 - 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. Double-wall Spiral ducts and fittings.
  - 4. Sheet metal materials.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.

#### 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"
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Adhesives.
  - 2. Sealants and gaskets.

### 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.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. [McGill AirFlow LLC.](#)
  2. [MKT Metal Manufacturing.](#)
  3. [Sheet Metal Connectors, Inc.](#)
- 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) of the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. 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."
    - a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
  2. 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."
    - a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
  3. 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."
- D. Inner Duct: Minimum 0.028-inch (0.7-mm) solid sheet steel.
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

## 2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct

construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Duct Galvanized Coating Designation: G90.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Galvanized sheet metal for rectangular and round ductwork shall have a minimum gauge of 26.

## 2.5 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Manufacturers shall be as follows:
    - a. Certaineed
    - b. Owens Corning
    - c. Johns Manville
    - d. Knauf
  - 2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
  - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  - 3. Butt transverse joints without gaps, and coat joint with adhesive.
  - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
  - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not

- exceeding 18 inches longitudinally.
- 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- 9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- 10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 4 inches.
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F.
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
  - 1. Application Method: Brush on.
  - 2. Solids Content: Minimum 65 percent.
  - 3. Shore A Hardness: Minimum 20.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. VOC: Maximum 75 g/L (less water).
  - 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.



8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements as specified for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

#### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use

two-part tape sealing system.

- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article."
- B. If ducts are not listed in the "Duct Schedule" Article then seal unlisted ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Ducts:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension,

and shear capacities appropriate for supported loads and building materials where used.

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
  - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
  - 2. Test the following systems:
    - a. Ducts with a Pressure Class Higher Than **3-Inch wg**:
      - 1) Test representative duct sections totaling no less than **25 percent** of total installed duct area for each designated pressure class.
    - b. Exhaust Ducts with a Pressure Class of **2-Inch wg or Higher**:
      - 1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.
    - c. Outdoor Air Ducts with a Pressure Class of **2-Inch wg or Higher**:
      - 1) Test representative duct sections totaling no less than **50 percent** of total installed duct area for each designated pressure class.
  - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 4. Test for leaks before applying external insulation.
  - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
  - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
  - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
    - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.8 DUCT CLEANING

- A. Clean **[new]** **[and]** **[existing]** duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
  - 6. Provide drainage and cleanup for wash-down procedures.
  - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

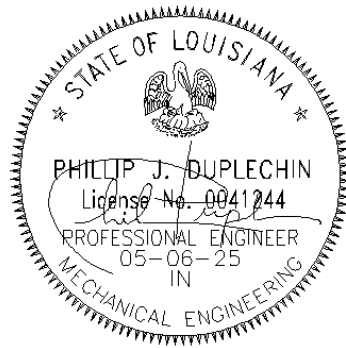
### 3.9 START UP

- A. Air Balance: Comply with requirements as specified.

### 3.10 DUCT SCHEDULE

- A. Supply Ducts:
  - 1. Ducts Connected to Constant-Volume Units, VRF Units and RTUs:
    - a. Pressure Class: Positive 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- B. Return Ducts:
  - 1. Ducts Connected to Constant-Volume Units, VRF Units and RTUs:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Exhaust Ducts:
  - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
    - c. SMACNA Leakage Class for Rectangular: 12.
    - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
  - 1. Ducts Connected to Constant-Volume Units, VRF Outside Air Units:
    - a. Pressure Class: Positive or negative 2-inch wg.
    - b. Minimum SMACNA Seal Class: A.
    - c. SMACNA Leakage Class for Rectangular: 6.
    - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- E. Duct Liner:
  - 1. Supply Diffuser Plenums: Fibrous glass, Type I, 1 inch thick.
  - 2. Return- Plenums: Fibrous glass, Type I, 1 inch thick.
  - 3. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

END OF SECTION 23 31 13



## **SECTION 23 33 00 - 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. Motorized dampers.
  - 3. Spin Collars.
  - 4. Fire dampers.
  - 5. Ceiling Radiation Dampers.
  - 6. Smoke Dampers.
  - 7. Combination Fire and Smoke Dampers.
  - 8. Flange connectors.
  - 9. Turning vanes.
  - 10. Duct-mounted access doors.
  - 11. Flexible connectors.
  - 12. Flexible ducts.
  - 13. Duct accessory hardware.
  - 14. Outside Air Intake Hoods, roof mounted.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 ASSEMBLY DESCRIPTION**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### **2.2 MATERIALS**

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
  - 1. Galvanized Coating Designation: G90.

2. Exposed-Surface Finish: Mill phosphatized.
- B. 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. Low-Leakage, Steel, Manual Volume Dampers:
  1. Manufacturers:
    - a. Greenheck.
    - b. Flex-Tek Group.
    - c. Nailor Industries Inc.
    - d. Pottorff.
    - e. Ruskin Company.
  2. Comply with AMCA 500-D testing for damper rating.
  3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  4. Suitable for horizontal or vertical applications.
  5. Frames:
    - a. Hat Channel shaped.
    - b. 0.094-inch- thick, galvanized sheet steel.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  6. Blades:
    - a. Multiple blade.
    - b. Opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, roll-formed steel, 0.064 inch thick.
  7. Blade Axles: Galvanized steel.
  8. Bearings:
    - a. Molded synthetic.
    - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
  9. Blade Seals: Neoprene.
  10. Jamb Seals: Stainless Steel.
  11. Tie Bars and Brackets: Galvanized steel.
  12. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Jackshaft:
  1. Size: 0.5-inch diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- C. 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 MOTORIZED DAMPERS

- A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- B. Manufacturers:
  1. Greenheck.
  2. Flex-Tek Group.
  3. Nailor Industries Inc.
  4. Pottorff.
  5. Ruskin Company.
- C. For Round Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CDRS25, Greenheck Model VCDR-53, Arrow Series 250SRD or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.
- D. For Rectangular Duct Type, Mechanical Contractor shall furnish and install motorized dampers at outdoor intakes as indicated on mechanical and architectural drawings. Damper shall be parallel blade motorized type equivalent to Ruskin CD36/PB, Arrow Series 1770, Greenheck Model VCD-23 or equal. Motorized dampers shall be operated by 120/1/60 electric actuator as indicated on plans. Provide Interlock with respective air handling unit. Interlock with respective air handling unit shall be low voltage. Damper shall be complete with outboard support bearing, blade and jamb seals. Dampers shall be low - leakage type.
- E. Frames:
  1. Hat shaped.
  2. 0.094-inch- thick, galvanized sheet steel.
  3. Mitered and welded corners.
- F. Blades:
  1. Multiple blade with maximum blade width of 6 inches.
  2. Opposed-blade design.
  3. Galvanized-steel.
  4. 0.064 inch thick single skin.
  5. Blade Edging: Closed-cell neoprene.
  6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- G. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
  1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- H. Bearings:
  1. Molded synthetic.
  2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

## 2.5 SPIN COLLARS

- A. All round take-offs to round branch duct shall be made with factory fabricated spin-type collar fittings with balancing damper and constructed of minimum 26 ga galvanized steel. The damper shall have a raised 2" handle with a high quality locking quadrant. A 3/8" continuous rod with "U" bolts connects the damper to the rod. Nylon end bearing are required where the rod penetrates the spin collar barrel. These spin-collars shall be as manufactured by Flexmaster Model FLD-B03, Dace #26ga MSD-C03 or approved equal.

## 2.6 FIRE DAMPERS

- A. The contractor shall furnish and install UL555 rated 1-1/2 hour fire dampers at the locations indicated on the drawings in new ducts and sound attenuators. The contractor shall provide dampers with sleeves and angle frames necessary to comply with the manufacturer's UL installation requirements. Dampers for vertical or horizontal air flow shall be provided as required.
- B. Manufacturers:
  1. Greenheck.
  2. Flex-Tek Group.
  3. Nailor Industries Inc.
  4. Pottorff.
  5. Ruskin Company.
- C. Fire damper shall be 100% free area and installed in wall and floor openings utilizing steel sleeves, angles, other materials and practice required to provide an installation equivalent to that utilized by the manufacturer when dampers are tested by UL555. Installation shall be in accordance with the damper manufacturer's instructions.
- D. Fire damper for rectangular ductwork and transfer openings shall be Ruskin type DIBD-B, Greenheck Model DFD-150-B (Basis of Design).
- E. Fire dampers for round ductwork shall be Ruskin Model DIBD-CR, Greenheck DFD-150-CR (Basis of Design).
- F. All fire dampers shall be installed per N.F.P.A. and U.L. requirements. Install U.L. approved sealant around the perimeter of the angle iron support at the sleeve and the wall in accordance with U. L. recommendations.
- G. All fire dampers shall meet the latest Class 1 leakage requirements.

## 2.7 CEILING RADIATION DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Nailor Industries Inc.
  2. Pottorff.
  3. Ruskin Company.

- B. General Requirements:
  - 1. Labeled according to UL 555C by an NRTL.
  - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation. If multiple temperature ratings are required in "Heat-Responsive Device" Paragraph below, indicate location of each heat-responsive-device rating on Drawings.
- E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links. UL has classified many damper designs ranging from 1/2 to 5 hours. Common values are included in "Fire Rating" Paragraph below. Select damper to match specific ceiling system. If multiple ratings are required, indicate location of each heat-responsive-device rating on Drawings.
- F. Fire Rating: 1 hours.

## 2.8 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff.
  - 3. Ruskin Company.
- B. Manufacturers offer additional features for engineered smoke-control system dampers.
- C. <http://www.specagent.com/Lookup?ulid=3450> General Requirements: Label according to UL 555S by an NRTL.
- D. Smoke Detector: Integral, factory wired for single-point connection.
- E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded corners.  
Vertical blades are available for special applications.
- F. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm) thick, galvanized sheet steel.
- G. Leakage: Class I.
- H. Rated pressure and velocity to exceed design airflow conditions.
- I. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- J. Damper Motors: two-position action. Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load

- will not require motor to operate in service factor range above 1.0.
- 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
- 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
- 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
- 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
- 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
- 7. Electrical Connection: 115 V, single phase, 60 Hz.

L. Accessories:

Retain applicable features in subparagraphs below.

- 1. Auxiliary switches for signaling fan control or position indication.
- 2. Test and reset switches, damper mounted.

## 2.9 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Greenheck Fan Corporation.
  - 2. Pottorff.
  - 3. Ruskin Company.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL. Available combination fire and smoke dampers include automatic-reopening types and types with electrothermal links that require link replacement after activation. Manufacturers offer additional features for engineered smoke-control system dampers. Retain first paragraph below for dynamic fire dampers.
- C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity. If both 1-1/2- and 3-hour ratings are required in "Fire-Rating" Paragraph below, indicate location of each rating on Drawings.
- D. Fire Rating: 1-1/2 and 3 hours. Type 304, stainless-steel dampers are available for corrosive atmospheres.
- E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded interlocking, gusseted corners. Retain one of two "Heat-Responsive Device" paragraphs below for either fusible or resettable links. Retain one of two temperature options in first "Heat-Responsive Device" Paragraph below for temperature-rated links to suit application requirements. Second option is standard.
- F. Heat-Responsive Device: Resettable, 165 deg F (74 deg C) rated, fire-closure device.

- G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- H. Smoke Detector: Integral, factory wired for single-point connection.  
Vertical blades are available for special applications.
- I. Blades: Roll-formed, horizontal, interlocking, **0.034-inch-** (**0.85-mm-**) thick, galvanized sheet steel.
- J. Leakage: Class I.
- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, **0.05-inch-** (**1.3-mm-**) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: two-position action. Default motor characteristics are specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
  - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
  - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
  - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of **150 in. x lbf** (**17 N x m**) and breakaway torque rating of **150 in. x lbf** (**17 N x m**).
  - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at **minus 40 deg F** (**minus 40 deg C**).
  - 6. Nonspring-Return Motors: For dampers larger than **25 sq. ft.** (**2.3 sq. m**), size motor for running torque rating of **150 in. x lbf** (**17 N x m**) and breakaway torque rating of **300 in. x lbf** (**34 N x m**).
  - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- P. Accessories:
  - 1. Auxiliary switches for signaling fan control or position indication.
  - 2. Test and reset switches, damper mounted.

## 2.10 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.11 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
    - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

## 2.12 DUCT ACCESS PANEL ASSEMBLIES

- A. Labeled according to UL 1978 by an NRTL.
- B. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- C. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- E. Minimum Pressure Rating: 10-inch wg, positive or negative.

## 2.13 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- 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.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
  - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.14 FLEXIBLE DUCTS

- A. Manufacturers:
  - 1. Thermaflex Model M-KE
  - 2. Flexmaster 1M
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
  - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1. (R6)
- C. Flexible Duct Connectors:
  - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.
  - 2. Non-Clamp Connectors: Liquid adhesive plus tape.

## 2.15 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## 2.16 OUTSIDE AIR INTAKE HOODS (ROOF MOUNTED)

- A. Furnish and install intake hoods where indicated on Plans. Intake hood shall be Shipman Model SRV-1, Greenheck Model FGI/FGR, Acme Skymaster or prior approved equivalent.
- B. Each hood shall be of all extruded aluminum construction. Base and throat shall have continuous welded mitered corners. Hood and extrude structural members shall utilize stainless steel fasteners. Each hood shall have a full 360 degree perimeter opening for air flow. Hoods shall be designed to withstand 100 mph winds. Hoods shall be furnished with hinges to swing open for access to dampers. Each hood shall be furnished with mesh insect screens and factory fabricated roof curb.
- C. Intake hoods shall have a 2-to-1 ratio of hood perimeter opening to throat area to provide an inlet velocity at the hood opening not to exceed 650 feet per minute.
- D. Hood shall be provided with a minimum of a 14" high roof curb.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire dampers according to UL listing.



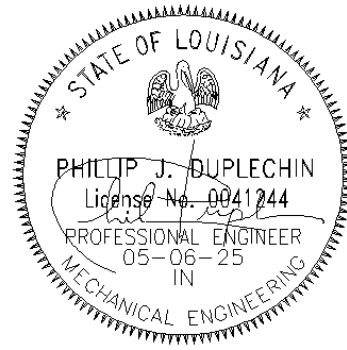
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. Upstream from duct filters.
  - 2. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 4. At each change in direction and at maximum 50-foot spacing.
  - 5. Control devices requiring inspection.
  - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

## SECTION 23 37 13 - DIFFUSERS, REGISTERS, GRILLES, AND LOUVERS



### 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. Louvered face diffuser.
  - 3. Continuous Tubular Diffuser (Fabric Duct)
  - 4. Fixed face registers and grilles.
  - 5. Louvers.
- 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.

### PART 2 - PRODUCTS

#### 2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:
  - 1. Manufacturers:
    - a. Titus.
    - b. Price Industries.
    - c. Nailor Industries.
    - d. Metalaire, Inc.
  - 2. Devices shall be specifically designed for variable-air-volume flows.
  - 3. Material: Aluminum.
  - 4. Finish: Baked enamel, white.
  - 5. Face Size: 24 by 24 inches.
  - 6. Face Style: Three cone.
  - 7. Mounting: T-bar.
  - 8. Pattern: Fixed.
- B. Louver Face Diffuser:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Size: See schedule on Drawings..
4. Mounting: Surface with beveled frame.
5. Pattern: Four-way core style.
6. Dampers: Radial opposed blade.
7. Accessories:
  - a. Square to round neck adaptor.

## 2.2 REGISTERS AND GRILLES

- A. Fixed Face Register:
  1. Manufacturers:
    - a. Titus.
    - b. Price Industries.
    - c. Nailor Industries.
    - d. Metalaire, Inc.
  2. Material: Aluminum.
  3. Finish: Baked enamel, white.
  4. Core Construction: Integral.
  5. Frame: 1 inch wide.
  6. Mounting: Lay in.

## 2.3 LOUVERS

- A. Provide louvers as scheduled in Drawings.

## 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.

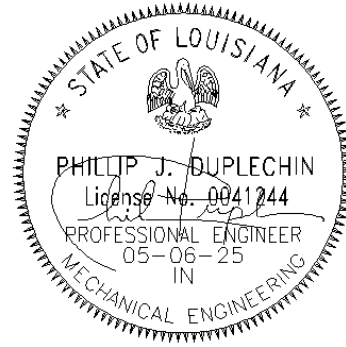
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 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 37 13

## SECTION 23 74 13 - PACKAGED ROOFTOP AIR CONDITIONING UNITS



### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Package roof top unit.
- B. Heat exchanger.
- C. Refrigeration components.
- D. Unit operating controls.
- E. Roof curb.
- F. Electrical power connections.
- G. Operation and maintenance service.

#### 1.2 RELATED SECTIONS

- A. Section 23 05 13 – Electric Motors.
- B. Section 23 05 48 - Vibration Isolation.
- C. Section 23 07 13 - Mechanical Insulation.
- D. Section 23 05 10 – Electrical Requirements for Electrical Equipment
- E. Section 23 09 00 – Temperature Controls

#### 1.3 REFERENCES

- A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems. (all)
- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration. (all)
- C. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard. (g/e, c/e above 135,000 btuh)
- D. AHRI 340 - Commercial and Industrial Unitary Heat Pump Equipment. (hp above 135,000 btuh)
- E. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment. (al

- F. ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
- G. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
- H. California Energy Commission Administrative Code - Title 20/24 - Establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California. (all)
- I. AHRI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment. (all under 135,000 btuh)
- J. AHRI 270 - Sound Rating of Outdoor Unitary Equipment. (all below 135,000)
- K. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.(all above 135,000 Btuh)
- L. ANSI/NFPA 70-1995 - National Electric Code. (all)

#### 1.4 SUBMITTALS

- A. Submit unit performance data including capacity, nominal and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start-up instructions.
- E. Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

#### 1.5 DELIVERY, STORAGE and HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

#### 1.6 WARRANTY

- A. Provide parts warranty (excluding refrigerant) for one year from start-up or 18 months from shipment, whichever occurs first.
- B. Provide five-year extended warranty for compressors.

- C. Provide five-year heat exchanger limited warranty.

## 1.7 REGULATORY REQUIREMENTS

- A. Unit shall conform to ANSI Z21.47/UL1995 for construction of packaged air conditioner ANSI\_Z21.47/UL\_1995\_REQUIREMENTS.
  - 1. In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.

## PART 2 PRODUCTS

### 2.1 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. APPROVED MANUFACTURERS
  - 1. Trane

### 2.2 GENERAL UNIT DESCRIPTION

- A. Unit(s) furnished and installed shall be packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on AHRI Standard. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and unit controls
- B. Unit(s) shall be 100% factory run tested and fully charged with R-410A
- C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- D. Units shall be convertible airflow design as manufactured.
- E. Wiring internal to the unit shall be colored and numbered for identification.

### 2.3 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with a pre-applied baked polyurethane enamel. Structural members with access doors and removable panels shall be a minimum 22 gauge.
- B. Unit's cabinet surface shall be tested 672 hours in salt spray test in compliance with ASTM B117.



- C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.
- D. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.
- E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
- F. Unit's base pan shall have a raised 1 1/8 inch high lip around the supply and return openings for water integrity.
- G. Provide 1/2 inch foil faced, fire retardant permanent, odorless glass fiber material. All edges must be captured so that there is no insulation exposed in the air stream.
- H. The base pan shall have no penetrations within the perimeter of the curb other than the raised 1 1/8 inch high down flow supply/return openings to provide and added water integrity precaution.
- I. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
- J. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

#### 2.4 AIR FILTERS

- A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Two-inch thick glass fiber disposable media filters shall be provided.
- B. Two-inch MERV 8 and MERV 13 media filters shall be available option.

#### 2.5 FANS AND MOTORS

- A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- C. Units shall be equipped with a direct drive plenum fan design. Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box. All motors shall be thermally protected. All indoor fan motors meet the U.S. Energy Policy Act of 1992 (EPACT).
- D. Outdoor and Indoor Fan motors shall be permanently lubricated and have internal thermal

overload protection.

- E. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- F. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

## 2.6 GAS FIRED HEATING SECTION

- A. Completely assembled and factory installed heating system shall be integral to unit, UL or CSA approved specifically for outdoor applications for use downstream from refrigerant cooling coils. Threaded connection with plug or cap provided. Provide capability for gas piping <<CONNECTION>>.
- B. Heating section shall be factory run tested prior to shipment.
- C. Induced draft combustion type with direct spark ignition system, redundant main gas valve, and 2-staged heat (6-10 ton).
- D. Gas Burner Safety Controls: Provide safety controls for the proving of combustion air prior to ignition, and continuous flame supervision. Provide flame rollout switches.
- E. Induced draft blower shall have combustion air proving switches and built-in thermal overload protection on fan motor.
- F. Units shall be suitable for use with natural gas or propane (field-installed kit) and also comply with the California Requirement for low NOx emission (Gas/Electric only).
- G. Heat Exchanger: Provide tubular section type constructed from 18-gauge aluminized steel.
- H. Through the base gas piping- the units shall include a standard through the base gas provision. This option shall have all piping necessary including black steel, manual gas shut off valve, elbows, and union. The manual shutoff valve shall include a 1/8 NPT pressure tap.
- I. Burners: Burners shall be of the in-shot type constructed of stainless steel.
- J. Limit controls: High temperature limit controls will shut off gas flow in the event of excessive temperatures resulting from restricted indoor airflow or loss of indoor airflow.

\*\*\*\*\* OR \*\*\*\*\*

## 2.6 ELECTRIC HEATING SECTION

- A. Provide heavy duty nickel chromium heating elements internally Delta connected for 240V, wye connection for 480V and 600V. Each heater package shall have automatically reset high limit control operating through heating element contactors. Backup protection is also provided via non-resettable single operation limits connected directly to high voltage. All heaters shall be individually fused from the factory, where

required, and shall meet all NEC and CEC requirements when properly installed. Power assemblies shall provide single point connection. Electrical heat modules shall be cULus listed.

- B. Heater shall be installed internal to unit cabinet.
- C. Heater shall be UL and CSA listed and approved and provide single point power connection.

## 2.7 EVAPORATOR COIL & SECTION

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- B. Microchannel evaporators provide streamlined tubes with small ports, and metallurgical tube-to-fin bond. The Microchannel coil has better heat transfer performance. Compact all-aluminum microchannel coils also help to reduce the unit weight. These all aluminum coils are recyclable, galvanic corrosion is also minimized due to all aluminum construction. Strong aluminum brazed structure provides better fin protection. In addition, flat streamlined tubes also make microchannel coils more dust resistant and easier to clean.
- C. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 600 psig and leak tested at 465 psig.
- D. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.
- E. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of Stainless Steel.

## 2.8 CONDENSER SECTION

- A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

Micro channel coil has flat streamlined tubes with small ports, and metallurgical tube to fin bond. Microchannel coil has better heat transfer performance. Microchannel condenser coil can reduce system refrigerant charge by up to 50% because of smaller internal volume, which reduces the unit weight. These all aluminum coils are recyclable. Galvanic corrosion is also minimized due to all aluminum construction. Strong aluminum brazed structure provides better fin protection and quality. In addition, flat streamlined tubes also make Microchannel coils more dust resistant and easier to clean.

## 2.9 REFRIGERATION SYSTEM

- A. All units shall have direct drive hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate.

- B. Provide with thermostatic temperature motor winding control for protection against excessive temperatures caused by over/under voltage operation or loss of charge. Also provide high and low pressure switches.
- C. Thermal Expansion valves are standard for all models.
- D. Units shall have cooling capabilities down to 0 degree F as standard with microprocessor controls (40 degrees F with electromechanical controls. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.
- E. Provide each unit with refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.

## 2.10 OUTDOOR AIR SECTION

- A. Motorized outside air damper 0-50%

## 2.11 OPERATING CONTROLS

- A. Provide factory-wired roof top units with 24-volt electro-mechanical control circuit with control transformers, contactors pressure lugs or terminal block for power wiring. Contractor to provide DISCONNECT DEVICE. Units shall have single point power connection as standard. Field wiring of zone controls to be NEC Class II.

## 2.12 STAGING CONTROLS

- A. Provide NEC Class II, electronic, adjustable zone control to maintain zone temperature setting
- B. Provide programmable electronic microcomputer-based zone control.
  - 1. Zone control shall incorporate:
    - a. Automatic changeover from heating to cooling.
    - b. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
    - c. Instant override of setpoint for continuous or timed period from one hour to 31 days.
    - d. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
    - e. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.
    - f. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.
  - 2. Zone sensor display shall be capable of:
    - a. Time of day.
    - b. Actual room temperature.
    - c. Programmed temperature.

- d. Programmed time.
- e. Duration of timed override.
- f. Day of week.
- g. System mode indication: heating, cooling, low battery, and fan on.

#### 2.13 ROOF CURB

- A. Contractor shall provide factory supplied roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
- B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

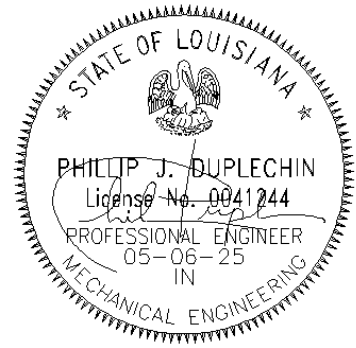
- A. Contractor shall verify that roof is ready to receive work and opening dimensions are as specified.
- B. Contractor shall verify that proper power supply is available.

#### 3.2 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

END OF SECTION 23 74 13

## SECTION 23 90 20 - TEMPERATURE CONTROLS



### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

##### A. Section Includes:

1. Thermostats.
2. Thermostat Covers.
3. Float Switches.
4. Motorized Dampers.
5. Exhaust Fans.
6. Smoke Detectors.
7. Control Wiring.

#### 1.3 ACTION SUBMITTALS

##### A. Shop Drawings:

1. General Requirements.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

### PART 2 - PRODUCTS

#### 2.1 PACKAGED A/C UNIT (A/C-1)

- A. Provide Hand/Off/Auto Thermostat by vendor to match equipment setup.

#### 2.2 SMOKE DETECTOR

- A. The Mechanical Contractor shall furnish and install a smoke detector in the supply duct and return duct of all air handlers delivering 2000 C.F.M. or above. Interlock the smoke detector to de-energize fan on actuation of detector.
- B. Smoke detectors shall have auxiliary contacts for interlock with the fire alarm system. Coordinate installation and selection of smoke detectors. Entire installation shall meet UL requirements for interlock with building fire alarm and security system.

- C. Provide remote audible and visual alarm unit with remote reset (one per AHU with smoke detector) in accordance with latest N.F.P.A. 90A requirements.
- D. Dual-chamber, ionization smoke detectors: The combination detector head and twist-lock base shall be UL listed compatible with a UL listed fire alarm panel.
- E. The smoke detector shall have a flashing status indication LED or visual supervision. When the detector is actuated, the flashing LED shall latch on steady and at full brilliance. The detector may be reset by activating the control panel remote reset switch.
- F. The sensitivity of the detector shall be monitored without removal of the detector head. Metering set points shall be accessible on the exterior of the detector head. Field adjustment the sensitivity shall be possible when conditions require a change.
- G. It shall be possible to perform a functional test of the detector without the need of generating smoke. The test method must simulate effects of products of combustion in the chamber to ensure testing of all detector circuits.
- H. Voltage and RF transient suppression techniques shall be employed to minimize false alarm potential. A gated alarm output shall be used for additional detector stability.
- I. Auxiliary SPDT relays and/or remote LED alarm indicators shall be installed as required.
- J. Duct mounted smoke detectors shall shut down the associated air handling unit fan motor and fire/smoke damper. This contractor shall provide all equipment and labor as required to accomplish same.
- K. 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 CONTROL WIRING

- A. All wiring required in the control systems, including electrical connections for the thermostats, firestats, smoke detectors, exhaust fans and all interlocking motor control wiring shall be furnished and installed by Mechanical Contractor.
- B. All wiring shall be in conduit and in accordance with the National Electrical Code (N.E.C.).
- C. All control wiring located outdoors shall be installed in rigid or intermediate metal conduit.
- D. All control wiring located indoors where an accessible ceiling is not available shall be installed in E.M.T. conduit.
- E. All control wiring located above accessible ceilings shall be N.E.C. approved cable. All control wiring located above accessible ceilings used as air plenums shall be N.E.C. approved "plenum cable".
- F. All conductors shall be copper. Conductors used for power circuits shall be #12 TW minimum. Conductors used for control circuits shall be #18 TW (single strand) minimum. Conductors used for sensor circuits shall be #18 TW (single strand) minimum. Control wiring for DX equipment thermostats shall be 10 conductor cables.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify compatibility with and suitability of substrates.
- B. Examine roughing-in for products to verify actual locations of connections before installation.
  - 1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
  - 2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

END OF SECTION 23 90 20



## **SECTION 26 01 00 – ELECTRICAL GENERAL CONDITIONS**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION**

- A. The General Conditions and all pertinent sections are part of this specification, and the Contractor shall consult them in detail in instruction pertaining to this work. He shall consult all other sections of the specifications to determine if he is required to perform any work related to that particular section.

#### **1.2 SCOPE OF WORK**

- A. The work contemplated under this specification comprises the furnishing of all labor and material required and necessary for the complete installation of electrical wiring in conduit for lighting control and power from existing panelboards to each ultimate outlet hereinafter specified and/or shown on the accompanying drawings. Said work shall be done in accordance with the latest edition of the National Electrical Code, NFPA codes and all local codes and ordinances. The specifications are intended to describe a complete workable system and bidders shall report any discrepancies or omissions preventing such workability prior to the time of the bids are submitted.
- B. The work covered by this specification shall be shown on plans and called for herein, and shall be comprised generally of the following:
  - 1. Furnish and install all conduit and wiring raceways, conductors, disconnects, panels, etc.
  - 2. Furnish and install feeders and branch circuits.
  - 3. Furnish and install service to all mechanical devices.
  - 4. Furnish and install light fixtures, power outlets, and all other electrical devices shown on plans.
- C. All equipment installed by this contractor shall be installed in strict accordance with instructions of the manufacturer.
- D. He shall install his work to meet existing conditions as found at the building site.
- E. The Electrical Contractor shall refer to the Architectural and Structural details for information in regard to the Architectural details. His work shall be done in strict accordance with local and state ordinances governing this class of work.

#### **1.3 REJECTED WORK AND MATERIALS**

- A. Should contractor introduce any materials different from those called for and described in specifications are shown on plans, it must on notification from the engineers, be immediately removed from building or premises.

#### **1.4 SHOP DRAWINGS**

- A. Before proceeding with work and/or within thirty (30) days award of the General Contract for this work, the Electrical Contractor shall furnish to the Architect/Engineer, complete shop and working drawings of such apparatus, equipment, controls insulation, etc. to be provide in this

project. These drawings shall give dimensions, weights, mounting data, performance curves, and other pertinent information. Shop drawings to be submitted as listed below.

1. Panels/Panelboards/Switchboards.
2. Disconnects.
3. Lighting Fixtures.
4. Conduit Fittings.
5. Electrical Devices.

- B. The contractor may be required to submit shop drawings on any other material he supplies in construction of this project. These drawings shall be submitted at time requested by Architect/Engineer.

#### 1.5 ADDITIONS AND CHANGES

- A. The accompanying drawings show approximate location of feeders, branch circuits, light and power circuits, etc. Complete and accurate details in regard to locations of outlets, apparatus, etc. from location shown shall be made before roughing-in and without additional cost to the owner.

#### 1.6 STANDARDS AND WORKMANSHIP

- A. All material shall be new and listed by UL as conforming to its standards. Work shall be executed in a workmanship manner and present a neat, finished appearance when completed.

#### 1.7 PRIOR APPROVAL AND DRAWINGS

- A. Whenever manufacturers or trade names are mentioned in these plans or specifications, the words "or approved equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only and should not in any way be construed to infer a preference. Equivalent products which meet the Engineer's approval will be accepted, however these products must be submitted to the Engineer a minimum of ten (10) days prior to bid date. Submission shall be included manufacturer's name, model number, rating table and construction features. Upon receipt and checking of this submittal, the Architect will issue an addendum listing items which are approved as equivalent to those specified. The Contractor shall base his bid solely on the items specified or included in the "Prior Approval Addendum" as no other items will be acceptable. Prior approval of a particular piece of equipment does not mean automatic final acceptance and will not relieve the Contractor of the responsibility of assuring himself that this equipment is in complete accord with plans and specifications and will fit into the space provided. Submit shop drawings on all items of equipment for approval as hereinafter specified. The Engineer's approval of shop drawings shall not relieve the Contractor from the responsibility of incorrectly figured dimensions or any other error that may be contained in these drawings. The omissions from the shop drawings, or

specifications, even though approved by the Engineer, shall not relieve this Contractor from furnishing and erecting same. **Prior Approvals submitted electronically will not be accepted.**

#### 1.8 GAURANTEE

- A. The Contractor for this work shall be required to keep the work installed by him in repair and perfect working order for one (1) year from date of completion and final acceptance; said guarantee shall be based on defective materials and substandard workmanship. Contractor shall furnish, free of cost to owner, all materials and labor necessary to comply with this guarantee.

#### 1.9 LAWS, PERMITS AND INSPECTIONS

- A. This contractor shall at his own cost obtain all necessary permits, pay all legal feed and charges and comply with all building and safety laws, ordinances and regulations relating to the building and the public health and safety, including NEC, NFPA, IBC, AND OSHA.
- B. Pay any and all fees required by local electric utility company to obtain electrical services outlined.

#### 1.10 TESTS

- A. After installation is complete and at such time as the Engineers may direct, Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with requirements of this specification. The test shall be performed in the presence of Engineers. Contractor shall furnish all instruments and personnel required for the test.

#### 1.11 CUTTING AND PATHNG

- A. Contractor shall do all cutting and patching where necessary at his own expense with approval of the Engineers as to cutting of any structural beams or joists, but all patching shall be done by crafts whose work is involved. After initial surfacing has been done, all further cutting, patching, and painting shall be done at this contractor's expense.

#### 1.12 SAFETY PRECUATIONS

- A. Contractor shall furnish and place proper guards for prevention of accidents. He shall provide and maintain any other necessary construction required to secure safety of life or property, including maintenance of sufficient lights during all night hours to secure such protection.
- B. Temporary electrical services shall be provided by electrical contractor during construction and shall be maintained in perfect condition. Frayed, loose or opened connections shall not be used for temporary services. The Electrical Contractor shall use only equipment in first class working conditions for construction services. Contractor shall not use electrical services at existing area for construction unless otherwise authorized by owner.

#### 1.13 SUPERVISION

- A. Contractor shall personally, or through an authorized and competent representative, constantly supervise the work done from beginning to completion and final acceptance. To the best of his

ability, he shall keep the same foreman and workmen throughout the project duration. During the progress of work, it shall be subject to inspection by the representatives of the Engineers, and at these times, the contractor shall furnish the required information.

1.14 INSERTS AND OPENINGS.

- A. Contractor shall furnish and install all inserts and hangers required to support conduit, cables, wireways, disconnect switches, etc.

1.15 OPENINGS THROUGH WALLS AND FLOORS

- A. Provide all slots, sleeved holes, and other openings necessary through walls and floors, and through any other parts of the structure. Where conduits pass through walls which are intended as rated fire walls, leave-outs, penetrations, or sleeves shall be sealed so as not to interfere with the rating of the wall.

1.16 BACKFILLING

- A. Contractor shall be responsible to backfill any trenches for electrical runs under the building, paving, or any area of the site by backfilling the bottom of the trench-up to the top of the conduit with sand, then placing compact fill in 6" layers using power tamping equipment.

1.17 RECORD DRAWINGS

- A. The Contractor shall be provided with a set of prints of the original bidding documents by the Architect. The Contractor Shall then have a set of sepia (reproducible plans) made.
- B. If the Contractor elects to vary from the contract documents and secures approval from the Architect for any phase of work, he shall record in a neat and readable manner, ALL such variances on the print in red. These changes shall be then transferred to the permanent set (sepia) at the completion of the job. Both the sepia and the original print shall be returned to the Engineer for documentation.
- C. All deviations from sizes, locations and from all other features of the installations shown in the Contract Documents shall be recorded.
- D. In addition, it shall be possible using these drawings to correctly and easily locate, identify and establish sizes of all piping, directions, and the like, as well as other features of work which will be concealed underground and/or in the finished building. Locations of underground work shall be established by dimensions to columns, lines, or walls, locating all turns, etc., and by properly referenced centerline.
- E. For work concealed in the building, sufficient information shall be given so it can be located with reasonable accuracy and ease. In some cases, this may be dimensions. In others, it may be sufficient to illustrate the work on the drawings in relation to the spaces in the building near which it was actually installed. Architect's/Engineer's decision in this matter will be final.
- F. The following requirement apply to all "record" drawings:
  - 1. The shall be maintained at the contractor's expense.
  - 2. All such drawing shall be done carefully and neatly and, in a form, approved by the Engineer.

3. Additional drawings shall be provided as necessary for clarification.
4. They shall be kept up-to-date during the entire course of the work and shall be available upon request for examination by Engineer and when necessary, to establish clearances for other parts of the work.
5. "Record" drawings shall be returned to the Architect/Engineer upon completion of the work and are subject to approval of the Engineer.
6. The Contractor shall refer to the Architectural section under "RECORD DRAWINGS" for further requirement and procedures.

END OF SECTION 26 01 00

## **SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete equipment bases.
  - 7. Electrical demolition.
  - 8. Cutting and patching for electrical construction.
  - 9. Touchup painting.

#### **1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. IMC: Intermediate metal conduit.
- D. LFMC: Liquid tight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

#### **1.4 SUBMITTALS**

- A. Shop Drawings: Dimensioned plans and sections or elevation layouts of electricity-metering equipment.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.
  - 1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.
- C. Coordinate electrical service connections to components furnished.
  - 1. Coordinate installation and connection of exterior underground utilities and services, including provision for electricity-metering components.
  - 2. Comply with requirements of authorities having jurisdiction.
- D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces. Access doors and panels are specified in Specification Section "Access Doors."
- E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.
- F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

## PART 2 - PRODUCTS

### 2.1 PRODUCT

- A. EMT: ANSI C80.3, zinc-coated steel, with compression fittings.
- B. FMC: Zinc-coated steel.
- C. IMC: ANSI C80.6, zinc-coated steel, with threaded fittings.
- D. LFMC: Zinc-coated steel with sunlight-resistant and mineral-oil-resistant plastic jacket.
- E. RNC: NEMA TC 2, Schedule 40 PVC, with NEMA TC3 fittings.

- F. Raceway Fittings: Specifically designed for the raceway type with which used.

## 2.2 CONDUCTORS

- A. Conductors, No. 10 AWG and Smaller: Solid copper.
- B. Conductors, larger than No. 10 AWG: Standard copper.
- C. Insulation: Thermoplastic, rated at 75 deg C minimum.
- D. Wire Connectors and Splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

## 2.3 SUPPORTING DEVICES.

- A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Slotted-Steel Channel Supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.
- D. Slotted-Steel Channel Supports: Comply with Specification Section "Metal Fabrications" for slotted channel framing.
  - 1. Channel Thickness: Selected to suit structural loading.
  - 2. Fittings and Accessories: Products of the same manufacturer as channel supports.
- E. Nonmetallic Channel and Angle Systems: Structural-grade, factor-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at maximum of 8 inches o.c., in at least one surface.
  - 1. Fittings and Accessories: Products of the same manufacturer as channels and angles.
  - 2. Fittings and Accessory Material: Same as channels and angles, except metal items may be stainless steel.
- F. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.
- G. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.
- H. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable-iron casting with hot-dip galvanized finish.
- I. Expansion Anchors: Carbon-steel wedge or sleeve type.
- J. Toggle Bolts: All-steel springhead type.



- K. Powder-Driven Threaded Studs: Heat-treated steel.

## 2.4 ELECTRICAL IDENTIFICATION

- A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A 13.1, NFPA 70, and these specifications.
- B. Raceway and Cable Labels: Comply with ANSI A 13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.
  - 1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
  - 2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather, and chemical resistant coating.
  - 3. Color: Black letters on orange background.
  - 4. Legend: Indicates voltage.
- C. Colored Adhesive marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick.
- D. Underground Warning Tape: Permanent, bright colored, continuous printed, vinyl tape with the following features:
  - 1. Not less than 5 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend that indicates type of underground line.
- E. Tape Markers for Wire: Vinyl or vinyl-coated, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suite coding scheme.
- G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminated punch or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.
- H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finished signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.
- I. Exterior Warning and Caution Signs: comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading preprinted, cellulose-acetate butyrate signs with 0.0396-inch, galvanized-steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws, or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

## 2.5 CONCRETE BASES

- A. Concrete Forms and Reinforcement Materials: As specified in Division 3 Section “Cast-in-Place Concrete.”
- B. Concrete: 4000-psi, 28-day compressive strength as specified in Division 3 Section “Cast-in-Place Concrete.”

## 2.6 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer’s paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommend by item manufacturer.

## PART 3 - EXECUTION

### 3.1 ELECTRICAL EQUIPMENT INSTALLATION

- A. Temperature ratings of all equipment lugs and terminations shall be compatible with those of the wire or cable per NEC 110-14(C) and 110-40 as applicable.
- B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide the maximum possible headroom.
- C. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

### 3.2 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Selection of Supports: Comply with manufacturer's written instructions.
- E. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb design load.

### 3.3 RACEWAY APPLICATION

- A. Use the following raceways for outdoor installations:

1. Exposed: IMC or Rigid Steel.
  2. Concealed: IMC or Rigid Steel.
  3. Underground, Single Run: RNC.
  4. Underground, Grouped: RNC.
  5. Connection to Vibrating Equipment: LFMC.
  6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4.
- B. Use the following raceways for indoor installation:
1. Exposed: EMT.
  2. Concealed: EMT.
  3. Connection to Vibrating Equipment: FMC; except in wet or damp locations, use LFMC.
  4. Damp or Wet Locations: IMC.
  5. Boxes and Enclosures: NEMA 250, Type 1, unless otherwise indicated.

### 3.4 RACEWAY AND CABLE INSTALLATION

- A. Concealed raceways and cables, unless otherwise indicated, within finished walls, ceilings, and floors.
- B. Install raceways and cables at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Locate horizontal raceways runs above water and steam piping.
- C. Use temporary raceway caps to prevent foreign matter from entering.
- D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.
- E. Use raceway and cable fittings compatible with raceways and cables and suitable for use and location.
- F. Install raceways below slab foundations and leave at least 6-inch bury depth below vapor barrier. Compact as per specifications in 6-inch layers using power tamping equipment.
- G. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel monofilament plastic line with no less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.
- H. Install telephone and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- I. Connect motors and equipment subject to vibration, noise transmission, or movement with a maximum of 72-inch flexible conduit. Install FMC in wet or damp locations. Install separate ground conductor across flexible connections.
- J. Set floor boxes level and rim after installation to fit flush to finish floor.

### 3.5 WIRING METHODS FOR POWER, LIGHTING, AND CONTROL CIRCUITS.

- A. Feeders: Type THHN/THWN insulated conductors in raceway.
- B. Underground Feeders and Branch Circuits: Type THWN.
- C. Branch Circuits: TYPE THHN/THWN insulated conductors in raceway, 3/4" minimum conduit when raceways below grade.
- D. Remote-Control Signaling and Power-Limited Circuits: Type THHN/THWN insulated conductors in raceway for Classes 1,2, and 3, unless otherwise indicated.

### 3.6 WIRING INSTALLATION

- A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- B. Install wiring at outlets with at least 8-inches of slack conductor at each outlet.
- C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

### 3.7 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Selection of Supports: Comply with manufacturer's written instructions.
- D. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four: minimum of 200-lb design load.

### 3.8 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded steel hanger rods, unless otherwise indicated.

- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of malleable-iron hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Simultaneously install vertical conductor supports with conductors.
- J. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- K. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- L. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.
- M. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
  - 1. Wood: Fasten with wood screws or screw-type nails.
  - 2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  - 3. New Concrete: Concrete inserts with machine screws and bolts.
  - 4. Existing Concrete: Expansion bolts.
  - 5. Instead of expansion bolts, threaded studs driven by a powder charge and provided with lock washers may be used in existing concrete.
  - 6. Steel: Welded threaded studs or spring-tension clamps on steel.
  - 7. Welding to steel structure may be used only for threaded studs, not for conduits, pipe straps, or other items.
  - 8. Light Steel: Sheet-metal screws.
  - 9. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.9 IDENTIFICATION MATERIALS AND DEVICES

- A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Coordinate names, abbreviations, colors, and other designation used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout project.

- C. Self-Adhesive Identification Products: Clean surfaces before applying.
- D. Identify raceways and cables with color banding as follows:
  - 1. Bands: Pretensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
  - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.
- F. Install continuous underground plastic markers during trench backfilling, for exterior underground power, control, signal, and communication lines located directly above power and communication lines. Locate 6 to 8 inches below finished grade. If width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches, overall, use a single line marker.
- G. Color-code 208/120 volt system secondary service feeder and branch-circuit conductors throughout the secondary electrical system as follows:
  - 1. Phase A: Black.
  - 2. Phase B: Red.
  - 3. Phase C: Blue.
  - 4. Neutral: White.
- H. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
- I. Install engraved-laminated emergency-operating signs with white letters on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

### 3.10 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly. Firestopping materials and installation requirements are specified in Specification Section "Firestopping."

### 3.11 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger, in both directions, than supported unit. Follow supported equipment manufacturer's anchorage recommendations and setting templates for anchor-bolt and tie locations, unless otherwise indicated. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Specification Section "Cast-in-Place Concrete."

### 3.12 CUTTING AND PATCHING

- A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. Perform cutting by skilled mechanics of trades involved.
- B. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Repair and refinish materials and other surfaces by skilled mechanics of trades involved.

### 3.13 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work, including the following:
  - 1. Raceways.
  - 2. Building wire and connectors.
  - 3. Supporting devices for electrical components.
  - 4. Electrical identification.
  - 5. Electricity-metering components.
  - 6. Concrete bases.
  - 7. Cutting and patching for electrical construction.
  - 8. Touchup painting.
- B. Test Owner's electricity-metering installation for proper operation, accuracy, and usability of output data.
  - 1. Connect a load of known kW rating, 1.5 kW minimum, to a circuit supplied by the metered feeder.
  - 2. Turn off circuits supplied by the metered feeder and secure them in the "off" condition.
  - 3. Run the test load continuously for eight hours, minimum, or longer to obtain a measurable meter indication. Use a test load placement and setting that ensure continuous, safe operation.
  - 4. Check and record meter reading at end of test period and compare with actual electricity used based on test load rating, duration of test, and sample measurements of supply voltage at the test load connection. Record test results.
  - 5. Repair or replace malfunctioning metering equipment or correct test setup; then retest. Repeat for each meter in installation until proper operation of entire system is verified.

### 3.14 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint. Paint materials and application requirements are specified in Specification Section "Painting."
  - 1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  - 2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  - 3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.15 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00



## **SECTION 26 05 19 - CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

#### **1.2 SUBMITTALS**

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

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where paragraph titles below introduce lists, the following requirements apply for product selection.
  - 1. Manufacturers: Subject to compliance with requirements, provided products by the manufacturer specified.

#### **2.2 CONDUCTORS AND CABLES**

- A. Manufacturers:
  - 1. American Insulated wire Corp.: a Leviton company.
  - 2. General Cable Corporation.
  - 3. Southwire Company.
  - 4. AFC Cables
  - 5. Kaf Tech Cables
  - 6. Burndy Corp.
- B. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

- C. Conductor Material: Copper, solid conductor for No. 10 AWG and smaller, stranded for no. 8 AWG and larger.
- D. Conductor Insulation Types: Type THHN-THWN complying with NEMA WC 5.

## 2.3 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance: Type XHHW, single conductors in raceway.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- D. Feeders below Slabs-on-Grade, and in Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord.
- I. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable in raceway.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

### 3.2 INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.

- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Basic Electrical Materials and Methods."
- F. Seal around cables penetrating fire-rated elements according to Specification Section "Through-Penetration Firestop Systems."
- G. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches of slack.

### 3.3 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.

END OF SECTION 26 05 19

## **SECTION 26 05 26 - GROUNDING AND BONDING**

### **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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Data: For the following:
  - 1. Ground rods.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Submit written test reports to include the following.
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed test and corrective action taken to achieve test results that comply with requirements.

#### **1.4 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 1. Comply with UL 467.
- C. Comply with NFPA 70: for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

- D. Comply with NFPA 780 and UL 96 when interconnection with lighting protection systems.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURES

- A. Manufactures: Subject to compliance with requirements, provide products by one of the following:
  - 1. Grounding Conductors, Cables, Connectors, and Rods.
    - a. Apache Grounding/Erico Inc.
    - b. Boggs, Inc.
    - c. Chance/Hubbell
    - d. Copperweld Corp.
    - e. Dossert Corp.
    - f. Erico Inc.: Electrical Group.
    - g. Framatome Connectors/Burndy Electrical.
    - h. Galvan Industries, Inc.
    - i. Ideal Industries, Inc.
    - j. ILSCO.
    - k. Kearney/Cooper Power Systems.
    - l. Korns: C.C. Korns Co.: Division of Robroy Industries.
    - m. Lyncole XIT Grounding.
    - n. O-Z/Gedney Co.: a business of the EGS Electrical Group.
    - o. Racor, Inc.; division of Hubbell.
    - p. Salisbury; W.H. Salisbury & Co.
    - q. Superior Grounding Systems, Inc.
    - r. Thomas & Betts, Electrical.

### 2.2 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Stranded cable.
- F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- G. Bare Copper conductors: Comply with the following:
  - 1. Solid Conductors: ASTM B3.
  - 2. Assembly of Stranded Conductors: ASTM B8.
  - 3. Tinned Conductors: ASTM B33.

H. Copper Bonding Conductors: As follows:

1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
3. Bonding Jumper: Bare (uninsulated) copper tape, braided bare (uninsulated) copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

I. Grounding Bus: Bare (uninsulated), annealed copper bars of rectangular cross section, with insulators.

2.3 CONNECTOR PRODUCTS

- A. Listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel.
  1. Size: 3/4 by 120 inches in diameter.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Use only copper conductors for both insulated and bare (uninsulated) grounding conductors in direct contact with earth, crushed stone, and similar materials.
- B. In raceways, use insulated equipment grounding conductors.
- C. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.
- D. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- E. Ground Rod Clamps at Test Wells: Use bolted pressure clamps with at least two bolts.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.
- G. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

### 3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
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.
- D. Computer Outlet Circuits: Install insulated equipment grounding conductor in branch-circuit runs from computer-area power panels or power-distribution units.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connect to the receptacle grounding terminal. Isolate grounding conductor from raceway and from panel board grounding terminal. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure and install a separate equipment grounding conductor. Isolate equipment grounding conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- H. Signal and Communication Systems: for telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum uninsulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 12 slot copper grounding bus.
  2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

- I. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a grounding electrode in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.

### 3.3 INSTALLATION

- A. Ground Rods:
  - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond interior metal piping systems and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- G. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.
- H. Proposed location by contractor for Engineer review in counterpoise shop drawings.

### 3.4 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.



1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
  2. Make connections with clean, bare (clean) 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.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare (uninsulated) grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare (uninsulated) grounding conductors, unless otherwise indicated.
- E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.
- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

### 3.5 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
  2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.
3. Provide 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.
    - a. Equipment Rated 500 kVA and Less: 10 ohms.
    - b. Equipment Rated 500 to 1000 kVA: 5 ohms.
    - c. Equipment Rated More Than 1000 kVA: 3 ohms.
    - d. Substations and Pad-Mounted Switching Equipment: 5 ohms.
    - e. Manhole Grounds: 10 ohms.
  4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

### 3.6 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 26 05 26

## **SECTION 16 05 33 - RACEWAYS AND BOXES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Specification Section "Through-Penetration Firestop Systems" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  - 2. Division 16 Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 3. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings.

#### **1.3 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.

#### **1.4 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, boxes, enclosures, and cabinets.

- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
  - 1. Ceiling suspension assembly members.
  - 2. 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.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. 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 METAL CONDUIT AND TUBING

- A. Manufacturers:
  - 1. Grinnell Co./Tyco International; Allied Tube and Conduit Division.
  - 2. LTV Steel Tubular Products Company.
  - 3. O-Z Gedney; Unit of General Signal.
  - 4. Wheatland Tube Co.
- B. Rigid Steel Conduit: ANSI C80.1
- C. Aluminum Rigid Conduit: ANSI C80.5
- D. IMC: ANSI C80.6
- E. Plastic-Coated Steel Conduit and Fittings: NEMA RN 1.

- F. Plastic-Coated IMC and Fittings: NEMA RN1
- G. EMT and Fittings: ANSI C80.3
  - 1. Fittings: compression type.
- H. FMC: Zinc-coated steel.
- I. LFMC: Flexible steel conduit with PVC jacket.
- J. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

## 2.3 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers:
  - 1. American International.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. Aruco Corp.
  - 4. Cantex Inc.
  - 5. Certaineed Corp.; Pipe & Plastics Group.
  - 6. Condux International.
  - 7. ElecSYS, Inc.
  - 8. Lamson & Sessions; Carlon Electrical Products.
  - 9. Manhattan/CDT/Cole-Flex.
  - 10. RACO; Division of Hubbell, Inc.
  - 11. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC2, Schedule 40 and Schedule 80 PVC.
- D. ENT and RNC Fittings: NEMA TC3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.

## 2.4 METAL WIREWAYS

- A. Manufacturers:
  - 1. Hoffman.
  - 2. Square D.
  - 3. Wiegman.
- B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1 or 3R as required.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

- D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.
- E. Wireway Covers: Hinged type.
- F. Finish: Manufacturer's standard enamel finish.

## 2.5 SURFACE RACEWAYS

- A. Manufacturers:
  1. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
  2. Thomas & Betts Corporation.
  3. Walker Systems, Inc.; Wiremold Company (The).
  4. Wiremold Company (The); Electrical Sales Division.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
- C. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

## 2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers:
  1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc
  2. Emerson/General Signal; Appleton Electric Company.
  3. Erickson Electrical Equipment Co.
  4. Hoffman.
  5. Hubbell Inc.; Killark Electric Manufacturing Co.
  6. O-Z/Gedney; Unit of General Signal.
  7. RACO; Division of Hubbell, Inc.
  8. Robroy Industries, Inc; Enclosure Division.
  9. Scott Fetzer Co.; Adalete-PLM Division.
  10. Spring City Electrical Manufacturing Co.
  11. Thomas Betts Corporation.
  12. Walker Systems, Inc.; Wiremold Company (The).
  13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB1, type FD, with gasketed cover.
- D. Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Small Sheet Metal Pull and Junction Boxes:
- F. Cast-Metal Pull and Junction Boxes: cast aluminum with gasketed cover.
- G. Hinged-Cover Enclosures: Type 1, with continuous hinge cover and flush latch.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- H. Cabinets: Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

## 2.7 FACTORY FINISHES

- A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer's standard prime-coat finish ready for field painting.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors:
  1. Exposed: Rigid steel or IMC.
  2. Concealed: Rigid steel or IMC.
  3. Underground, Single Run: RNC.
  4. Underground, Grouped: RNC.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  6. Boxes and Enclosures: NEMA 250Type 3R.
- B. Indoors:
  1. Exposed: EMT.
  2. Concealed: EMT.
  3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
  4. Damp or Wet Locations: Rigid steel conduit.
  5. Boxes and Enclosures: NEMA Type 1, except as follows:
    - a. Damp or Wet Locations: NEMA Type 4.
- C. Minimum Raceway Size: 1/2-inch trade size above grade, 3/4" min. below grade.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
- E. Do not install aluminum conduits embedded in or in contact with concrete unless properly protected where routed through or in concrete.

### 3.2 INSTALLATION

- A. 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.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Division 16 Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- H. Raceways shall not be embedded in concrete slabs.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - 1. Use insulating bushings to protect conductors.
- K. Terminations:
  - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- L. 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.
- M. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-



degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

- N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- P. Flexible Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- Q. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.
- R. Set floor boxes level and flush with finished floor surface.
- S. Set floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 26 05 33

## **SECTION 26 05 53 - ELECTRICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes electrical identification materials and devices required to comply with, ANSI C2, NFPA 70, OSHA, and authorities having jurisdiction.

#### **1.3 SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.
- B. Schedule of Nomenclature: An index of electrical equipment and system components used in identification signs and labels.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.
- C. Comply with ANSI A13.1, and NFPA 70 for color-coding.

### **PART 2 - PRODUCTS**

#### **2.1 RACEWAY AND CABLE LABELS**

- A. Comply with NFPA 70, for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
  - 1. Color: Black letters on orange field.
  - 2. Legend: Indicates voltage and service.
- B. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear, weather- and chemical-resistant coating.
- C. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.

1. Not less than 6 inches wide by 4 mils thick.
  2. Compounded for permanent direct-burial service.
  3. Embedded continuous metallic strip or core.
  4. Printed legend indicating type of underground line.
- D. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- E. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch thick aluminum sheet, with stamped or embossed legend and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- F. Plasticized Card-stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, unless otherwise indicated, with eyelet for fastener.

## 2.2 NAMEPLATES AND SIGNS

- A. Engraved Plastic Nameplates and Signs: Engraving stock, melamine plastic laminate, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
- B. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32, stainless-steel machine screws with nuts and flat and lock washers.

## 2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon cable ties.
1. Minimum Width: 3/16 inch.
  2. Tensile Strength: 50 lb minimum.
  3. Temperature Range: Minus 40 to plus 185 deg F.
  4. Color: According to color-coding.
- B. Paint: Formulated for the type of surface and intended use.
1. Primer for Galvanized Metal: Single-component acrylic vehicle formulated for galvanized surfaces.
  2. Primer for Concrete Masonry Units: Heavy-duty-resin block filler.
  3. Primer for Concrete: Clear, alkali-resistant, binder-type sealer.
  4. Enamel: Silicone-alkyd or alkyd urethane as recommended by primer manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Install painted identification according to manufacturer's written instructions and as follows:
  - 1. Clean surfaces of dust, loose material, and oily films before painting.
  - 2. Prime surfaces using type of primer specified for surface.
  - 3. Apply one intermediate and one finish coat of enamel.
- E. Color Banding Raceways and Exposed Cables: Band exposed and accessible raceways of the systems listed below:
  - 1. Bands: Pretensioned, wraparound plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
  - 2. Band Locations: At changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
  - 3. Apply the following colors to the systems listed below:
    - a. Fire Alarm System: Red.
    - b. Fire-Suppression Supervisory and Control System: Red and yellow.
    - c. Combined Fire Alarm and Security System: Red and blue.
    - d. Security System: Blue and yellow.
    - e. Mechanical and Electrical Supervisory System: Green and blue.
    - f. Telecommunication System: Green and yellow.
- F. Caution Labels for Indoor Boxes and Enclosures for Power and Lighting: Install pressure-sensitive, self-adhesive labels identifying system voltage with black letters on orange background. Install on exterior of door or cover.
- G. Circuit Identification Labels on Boxes: Install labels externally.
  - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
  - 2. Concealed Boxes: Plasticized card-stock tags.
  - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent including voltage.
  - 4. Paint fire alarm junction box covers red.
- H. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

- I. Color-Coding of Secondary Phase Conductors: Use the following colors for service, feeder, and branch-circuit phase conductors:
  - 1. 208/120-V Conductors:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral White
  - 2. 480/277-V Conductors:
    - a. Phase A: Yellow.
    - b. Phase B: Brown.
    - c. Phase C: Orange.
    - d. Neutral Gray
  - 3. Factory apply color the entire length of conductors, except the following field-applied, color-coding methods may be used instead of factory-coded wire for sizes larger than No. 10 AWG:
    - a. Colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
- J. Power-Circuit Identification: Metal tags or aluminum, wraparound marker bands for cables, feeders, and power circuits in vaults, pull and junction boxes, manholes, and switchboard rooms.
  - 1. Legend: 1/4-inch- steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
  - 2. Tag Fasteners: Nylon cable ties.
  - 3. Band Fasteners: Integral ears.
- K. Apply identification to conductors as follows:
  - 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.
  - 3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- L. Apply warning, caution, and instruction signs as follows:
  - 1. Warnings, Cautions, and Instructions: Install to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated

- instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
2. Emergency Operation: Install engraved laminated signs with white legend on red background with minimum 3/8-inch- high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- M. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment, including central or master unit of each system. This includes power, lighting, communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Unless otherwise indicated, provide a single line of text with 1/2-inch- high lettering on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment using mechanical fasteners:
1. Panelboards, electrical cabinets, and enclosures.
  2. Access doors and panels for concealed electrical items.
  3. Electrical switchgear and switchboards.
  4. Disconnect switches.
  5. Enclosed circuit breakers.
  6. Power transfer equipment.
  7. Contactors.
  8. Remote-controlled switches.
  9. Dimmers.
  10. Control devices.
  11. Transformers.
  12. Battery racks.

END OF SECTION 26 05 53

## **SECTION 26 09 23 - LIGHTING CONTROL DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following lighting control devices:
  - 1. Time switches.
  - 2. Outdoor photoelectric switches.
  - 3. Switch-box occupancy sensors.
  - 4. Indoor occupancy sensors.
  - 5. Multipole contactors.
- B. Related Sections include the following:
  - 1. Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.

#### **1.3 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

#### **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### **1.6 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with EIII C62.41 and with UL 1449.

### 2.3 TIME SWITCHES Paragon EC Series or Intermatic ET Series

- A. Manufacturers:
  - 1. Area Lighting Research, Inc.
  - 2. Fisher Pierce.
  - 3. Grasslin Controls Corporation.
  - 4. Intermatic, Inc.
  - 5. Leviton Mfg. Company Inc.
  - 6. Lightolier Controls: a Genlyte Company.
  - 7. Lithonia Lighting.
  - 8. Paragon Electric Co.
  - 9. Square D.
  - 10. TORK.
  - 11. Touchplate Technologies, Inc.
  - 12. Watt Stopper (The)
- B. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.
  - 1. Contact Configuration: As indicated.
  - 2. Contact Rating: 30-A inductive or resistive, 240-V ac .
  - 3. Program: Single channel, 2 on-off set points on a 24-hour schedule with skip-a-day weekly schedule.
  - 4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program on selected channels.
  - 5. Astronomical Time: All channels.
  - 6. Battery Backup: For schedules and time clock.



## 2.4 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers:
  - 1. Area Lighting Research, Inc.
  - 2. Fisher Pierce.
  - 3. Grasslin Controls Corporation.
  - 4. Intermatic, Inc.
  - 5. Lightolier Controls: a Genlyte Company.
  - 6. Lithonia Lighting.
  - 7. Paragon Electric Co.
  - 8. Square D.
  - 9. TORK.
  - 10. Touchplate Technologies, Inc.
  - 11. Watt Stopper (The)
- B. Description: Solid state, with SPST or DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, and microprocessor input.
  - 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
  - 2. Time Delay: 15-second minimum, to prevent false operation.
  - 3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
  - 4. Mounting: Twist lock complying with IEEE C136.10 with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.

## 2.5 INDOOR PHOTOELECTRIC SWITCHES – where specified.

- A. Manufacturers:
  - 1. Allen Bradley/Rockwell Automation.
  - 2. Area Lighting Research, Inc.
  - 3. Cutler-Hammer; Eaton Corporation.
  - 4. Fisher Pierce.
  - 5. Grasslin Controls Corporation.
  - 6. Intermatic, Inc.
  - 7. Lithonia Lighting.
  - 8. MicroLite Corporation.
  - 9. Novitas, Inc.
  - 10. Paragon Electric Co.
  - 11. Square D.
  - 12. TORK.
  - 13. Touchplate Technologies, Inc.
  - 14. Watt Stopper (The)
- B. Ceiling-Mounting Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
  - 1. Sensor Output: contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20-A ballast load at 120 and 277 Volts AC, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150 mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with dead band adjustment.
5. Indicator: Two LEDs to indicate the beginning of on and off cycles.

## 2.6 SWITCH-BOX OCCUPANCY SENSORS

- A. Manufacturers:
  1. Bryant Electric; a Hubbell Company.
  2. Hubbell Lighting Inc.
  3. Leviton Mfg. Company
  4. Lightolier Controls: a Genlyte Company.
  5. Lithonia Lighting.
  6. MYTECH Corporation.
  7. Novitas, Inc.
  8. RAB Electric Manufacturing Inc.
  9. Sensor Switch, Inc.
  10. TORK.
  11. Unico Electronics; A Hubbell Company.
  12. Watt Stopper (The)
- B. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for LED drivers, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for LED drivers, or 1/3-hp motors, minimum.

## 2.7 INDOOR OCCUPANCY SENSORS

- A. Manufacturers:
  1. Hubbell Lighting Inc.
  2. Leviton Mfg. Company
  3. Lithonia Lighting.
  4. MYTECH Corporation.
  5. Novitas, Inc.
  6. RAB Electric Manufacturing Inc.
  7. Sensor Switch, Inc.
  8. TORK.
  9. Uneco Electronics; A Hubbell Company.
  10. Watt Stopper (The)
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
  1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keeps lighting off when selected lighting level is present.
  8. Fail Safe; In case of sensor failure, lighting fixtures shall remain on.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.8 MULTIPOLE CONTACTORS

- A. Manufacturers:
1. Allen Bradley/Rockwell Automation.
  2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  3. Cutler-Hammer; Eaton Corporation.
  4. Fisher Pierce.
  5. GE Industrial Systems; Total Lighting Control.
  6. Grasslin Controls Corporation.
  7. Hubbell Lighting Inc.
  8. Lithonia Lighting.
  9. MicroLite Corporation.
  10. TORK.
  11. Touchplate Technologies, Inc.
  12. Watt Stopper (The)
- B. Description: Electrically operated and electrically held.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Control-Coil Voltage: Match control power source.

## 2.9 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 16 Section "Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
- 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 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 26 09 23

## SECTION 26 24 16 - ENCLOSED SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. RFI: Radio-frequency interference.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current and voltage ratings.
    - c. Short-circuit current rating of panelboards and overcurrent protective devices.
    - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  - 2. Wiring Diagrams: Power, signal, and control wiring.

- C. Field quality-control test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtained panelboards, overcurrent protective devices, component, and accessories through one source from a single manufacturer.
- B. Product Options: Drawings indicated size, profiles, and dimensional requirements of panelboards and are based on the specified system indicate.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NEMA PB1.
- E. Comply with NFPA 70.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

#### 1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

#### 1.8 EXTRA MATERIAL

- A. Furnish extra material described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Keys: Six spares for each type of panelboard cabinet lock.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provided products by one of the following:
  - 1. Panelboards, Overcurrent Protective Devices, Controllers Contactors and Accessories:
    - a. General Electric Co.; Electrical Distribution & Protection Div.
    - b. Square D.
    - c. Eaton.

### 2.2 MANUFACTURED UNITS

- A. Enclosures: Flush and surface mounted cabinets. NEMA PB 1, Type 1.
  - 1. Rated for environmental conditions at installed location.
    - a. Outdoor Locations: NEMA 250, Type 3R.
    - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  - 3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
  - 4. Directional Card: With transparent protective cover mounted in metal frame, inside of panelboard door.
- B. Phase and Ground Buses:
  - 1. Material: Hard drawn copper, 98 percent conductivity.
  - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bond to box.
  - 3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
- C. Conductor Connectors: Suitable for use with conductor material.
  - 1. Main and Neutral Lugs: Compression type.
  - 2. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

### 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

### 2.4 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit breaker.



- C. Branch Overcurrent Protective Devices:
  - 1. For Circuit-Breaker Frame Sizes 125A and Smaller: Bolt-on circuit breakers.
  - 2. For Circuit-Breaker Frame Sizes Larger than 125A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors” concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.6 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  - 3. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings:
    - a. Instantaneous trip.
    - b. Long and short time pick up levels.
    - c. Long and short-time time adjustments.
    - d. Ground-fault pickup level, time delay, and I<sup>2</sup>t response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller; let-through ratings less than NEMA FU 1, RK-5.
  - 5. GFCI Circuit Breakers: Single and two-pole configurations with 5-mA trip sensitivity.
- B. Molded Case Circuit Breaker Features and Accessories: Stand frame sizes, trip ratings, and number of poles.
  - 1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - 2. Application Listing: Appropriate for application: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
  - 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
  - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - 5. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance and operation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flushed with wall finish.
- D. Install overcurrent protective devices and controllers.
  - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- G. Arrange conductors in gutters and within panelboard into associated circuit groups and bundle and wrap with wire ties after completing load balancing.
- H. All panel cans and covers with-in the same space shall be the same height.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Create a director to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are **NOT ACCEPTABLE**. Provide room being served identification for each circuit.
- C. Panel board Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion -resistant screws.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
  2. Test continuity of each line- and load-side circuit.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field test and prepare test reports:
- C. Perform the following field test and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  2. Correct malfunctioning units on -site, where possible, and retest to demonstrate compliance; otherwise replace with new units and retest.
- D. Load Balancing: After Substantial Completion, but not more than 69 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
  2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test reports.
  4. Tolerance: Difference exceeding 29 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
1. Follow-Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
  2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  3. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

### 3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416

## **SECTION 26 27 26 - WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Single and duplex receptacles, ground-fault circuit interrupters, integral surge suppression units, and isolated-ground receptacles.
  - 2. Single- and double-pole snap switches and dimmer switches.
  - 3. Device wall plates.
  - 4. Pin and sleeve connectors and receptacles.
  - 5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

#### **1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One of each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provided products by one of the following:
  - 1. Wiring Devices:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Leviton Mfg. Company Inc.
    - c. Pass Seymour/Legrand; Wiring Devices Div.
  - 2. Multioutlet Assemblies:
    - a. Hubbell Incorporated; Wiring Device-Kellems,
    - b. Wiremold Company (The).

### 2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: (Leviton 5362 or approved equal). Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.
- B. Straight-Blade: Heavy -Duty grade.
- C. GFCI Receptacles: Straight blade, non-feed-through type, Heavy-Duty grade, with integral NEMA WD6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter. (Leviton Model # GFNT2 or approved equal.)
- D. Isolated Ground Receptacle: Straight blade, Heavy Duty grade, duplex receptacle, with equipment grounding contacts connected only to the green grounding screw terminal of device and with inherent electrical isolation from mounting strap. (Leviton Model #5362-IG or approved equal.)
  - 1. Devices: Listed and labeled as isolated-ground receptacles.

2. Isolation Method: Integral to receptacle construction and not dependent on removable parts.
- E. TVSS Receptacles: Straight blade, NEMA WD6, Configuration 5-20R, with integral TVSS in line to ground, line to neutral, and neutral to ground.
1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp level rating of 500 volts and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.
  2. Active TVSS Indication: Visual only with light visible in face of device to indicate device is “active” or “no longer in service.”
  3. Identification: Distinctive marking on face of device to denote TVSS-type unit.
- F. USB Receptacles: See site plan symbol schedule.
- G. Tamper Resistant: Leviton TBR 20.

## 2.3 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.4 SWITCHES (Leviton Models 1221-2, 1222-2, 1223-2 and 1224-2 or approved equal.)

- A. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.
- B. Snap Switches: Heavy -Duty grade, quiet type.
- C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
1. Switch 20A, 120/277 Volts AC.
  2. Receptacle: NEMA WD6, Configuration 5-15R.
- D. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
  2. LED Lamp Dimmers: Modular, 277V, 50 Hz with continuously adjustable rotary knob, toggle switch, or slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch wire connecting leads.

## 2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Wet Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

## 2.6 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.

## 2.7 FINISHES

- A. Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Owner/Engineer.
  - 2. TVSS Devices: Blue.
  - 3. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install devices and assemblies' level, plumb, and square with building lines.
- B. Install wall dimmers to achieve indicated rating after derating for ganging according to manufacturer's written instructions.
- C. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.
- D. 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, multi-gang wall plates.
- E. Remove wall plates and protect devices and assemblies during painting.
- F. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

## 3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."
  - 1. Receptacles: Identify panelboard and circuit number form which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.3 CONNECTIONS

- A. Ground equipment according to Division 16 Section "Grounding and Bonding."
- B. Connect wiring according to Division 16 Section "Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated use those specified in UL 486A and UL 486B

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
  - 2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 26 27 26



## **SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
  - 1. Fusible switches.
  - 2. Non-fusible switches.
  - 3. Molded-case circuit breakers.
  - 4. Molded-case switches.
  - 5. Enclosures.

#### **1.3 DEFINITIONS**

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

#### **1.4 SUBMITTALS**

- A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each switch and circuit breaker.
  - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Current and voltage ratings.
    - c. Short-circuit current rating.

- d. UL listing for series rating of installed devices.
  - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Shop Drawings: Diagram power, signal, and control wiring.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Closeout Procedures," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
  - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. Product Selection for Restricted Space: Drawings indicated maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

## 1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Spares: For the following:
    - a. Fuses for Fusible Switches: 1% not less than on of each type.
    - b. Fuses for Fused Power Circuit Devices: 1% not less than on of each type.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Manufacturers:
  - 1. General Electric Co.; Electrical Distribution & Control Division.
  - 2. Square D/Group Schneider.
  - 3. Eaton
- B. Fusible Switch, 1200A and Smaller: NEMA KS1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Non-fusible Switch, 1200A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover I closed position.
- D. 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; and labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: Auxiliary set of contacts arrange to open before switch blades open.

### 2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

- A. Manufacturers:
  - 1. General Electric Co.; Electrical Distribution & Control Division.
  - 2. Square D/Group Schneider.
  - 3. Eaton
- B. Molded-Case Circuit Breaker: NEMA AB1, with interrupting capacity to meet available fault currents.
  - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.
  - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field -adjustable trip setting.
  - 3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
    - a. Instantaneous trip.

- b. Long and short-time pickup levels.
    - c. Long and short-time time adjustments.
    - d. Ground fault pickup level, time delay and I2t response.
  - 4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller and let-through ratings less than NEMA FU 1, RK-5.
  - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
  - 6. GFCI Circuit Breakers: Single and two pole configurations with 5-mA trip sensitivity.
- C. Molded-Case Circuit Breaker Features and Accessories:
- 1. Standard frame sizes, trip ratings, and number of poles.
  - 2. Lugs: Mechanical style suitable for number, size trip ratings, and conductor material.
  - 3. Application Listing: Type SWD for switching fluorescent lighting loads: Type HACR for heating, air-conditioning, and refrigerating equipment.
  - 4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-reset feature, and ground-fault indicator.
  - 5. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
  - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1 to 0.6 second time delay.
  - 7. Auxiliary Switch: Two SPDT switches with “a” and “b” contacts: “a” contacts mimic circuit-breaker contacts, “b” contacts operate in reverse of circuit-breaker contacts.
  - 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
  - 9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- E. Molded-Case Switch Accessories:
- 1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
  - 2. Application Listing: Type HACR for heating, air-conditioning, and refrigeration equipment.
  - 3. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide “dummy” trip unit where required for proper operation.
  - 4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1 to 0.6 second time delay. Provide “dummy” trip unit where required for proper operation.
  - 5. Auxiliary Switch: Two SPDT switches with “a” and “b” contacts: “a” contacts mimic circuit-breaker contacts, “b” contacts operate in reverse of circuit-breaker contacts.
  - 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

## 2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

## 2.5 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 CONCRETE BASES

- A. Coordinate size and location of concrete bases. Verify structural requirement with structural engineer.
- B. Concrete base is specified in Division 26 Section "Basic Electrical Materials and Methods", and concrete materials and installation requirements are specified in Division 3.

### 3.3 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA BP1.1, NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### 3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Basic Electrical Materials and Methods."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

### 3.5 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.6 IDENTIFICATION

- A. Identify field-installed conductors interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification".
- B. Enclosure Nameplates: Label each enclosure with engraved metal laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification".

### 3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.
  - 1. Inspect mechanical and electrical connections.
  - 2. Verify switch and relay type and labeling verification.
  - 3. Verify rating of installed fuses.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Infrared Scanning:
    - a. Initial Infrared Scanning: After Substantial completion, but not more than 50 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
    - c. Instruments, Equipment and Reports:
      - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      - 2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected remedial action taken, and observations after remedial action.

3.8 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.9 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.
- B. Inspect surfaces and repair damaged finishes.

END OF SECTION 262816

## **SECTION 26 43 13 - TRANSIENT VOLTAGE SUPPRESSION**

### **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 transient voltage surge suppressors for low-voltage power, control, and communication equipment.
- B. Related Sections include the following:
  - 1. Division 16 Section "Switchboards" for factory-installed transient voltage surge suppressors.

#### **1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Maintenance Data: For transient voltage suppression devices to include in maintenance manuals specified in Division 1.
- C. Warranties: Special warranties specified in this Section.

#### **1.4 QUALITY ASSURANCE**

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### **1.5 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 weeks in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.



- B. Service Conditions: Rate surge protective devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F.
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet above sea level.

## 1.6 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

## 1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Replaceable Protection Modules: One of each size and type installed.

## PART 2 - PRODUCTS

### 2.1 SERVICE ENTRANCE SUPPRESSORS: Current Technology SEL200 or Cutler Hammer CPS-M

- A. Surge Protective Device Description: Modular design with field-replaceable modules and the following features and accessories:
1. Fabrication using bolted compression lugs for internal wiring.
  2. Integral disconnect switch.
  3. Redundant suppression circuits.
  4. Redundant replaceable modules.
  5. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
  6. Red and green LED indicator lights for power and protection status.
  7. Audible alarm, with silencing switch, to indicate when protection has failed.
  8. One set of dry contacts rated at 5 a and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
  9. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 400 kA per phase.

- C. Connection Means: Permanently wired.
- D. Protection modes clamping voltage for grounded wye circuits with voltages of 480Y/277 and 208Y/120; 3-phase, 4-wire circuits, shall be as follows:
  - 1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.
  - 2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.
  - 3. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

## 2.2 CONTROL AND DATA TERMINALS

- A. Protectors for copper data and telephone conductors entering the building from the outside shall be as recommended by the manufacturer for the type of line being protected.

## 2.3 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- B. Install devices for panelboard and auxiliary panels with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
  - 1. Provide multipole, 15-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated or recommended by the suppressor manufacturer.

## 3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values

## 3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Complete startup checks according to manufacturer's written instructions.
  - 3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.19. Certify compliance with test parameters.

- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Verify that electrical wiring installation complies with manufacturer's installation requirements.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protective devices.
  - 1. Train Owner's maintenance personnel on procedures and schedules for maintaining suppressors.
  - 2. Review data in maintenance manuals. Refer to Specification Section "Contract Closeout."
  - 3. Review data in maintenance manuals. Refer to Specification Section "Operation and Maintenance Data."
  - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION 26 43 13

## SECTION 26 51 19 – LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Interior solid-state luminaires that use LED technology
  - 2. Lighting fixture supports.
  - 3. Exit signs.
- B. Related Sections include the following:
  - 1. Section 26093 “Lighting Control Devices” for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.2 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.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
  - 2. Fluorescent and high-intensity-discharge ballasts.
  - 3. Lamps.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

- C. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Specification Section "Operation and Maintenance Data," include the following:

- 1. Catalog data for each fixture. Include the diffuser, ballast, and lamps installed in that fixture.

#### 1.4 INFORMATION SUBMITTAL

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:
- B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.
- C. Product Certificates: For each type of luminaire.
- D. Sample warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.6 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace component of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period for all LED Fixtures: Five(5) years from date of Substantial Completion.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

#### 1.8 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

## 1.9 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## PART 2 - PRODUCTS

### 2.1 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 for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. CRI of minimum 80 CCT at 4000K (See Fixture Schedule).
- F. Rated lamp life of 50,000 hours minimum or equal to specified fixtures which is more.
- G. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- H. Internal driver.
- I. Nominal Operating Voltage: 120 Volt, 1 phase, 60hz.
  - 1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

### 2.2 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- D. 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.

4. Laminated Silver Metallized Film: 90 percent.

E. Plastic Diffusers, Covers, and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is scheduled.
  - b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

## 2.3 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.

## 2.4 LUMINAIRE SUPPORTS COMPONENTS

## 2.5 EXIT SIGNS

- A. General: Comply with authorities having jurisdiction for sign colors and lettering size.
- B. Internally Lighted Signs:
1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
  2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

## 2.6 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports, and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: Soft temper, zinc-coated, 12 gage.
- E. Wires For Humid Spaces: Annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.

## 2.7 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Luminaire Installation: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- C. Install lamps in each luminaire.
- D. Suspended Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
  - 4. Continuous Rows: Suspend from cable.
- E. Ceiling Grid Mounted Luminaires:
  - 1. Secure to any required outlet box.
  - 2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
- F. Identify systems components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260533 "Electrical Identification".

### 3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.



### 3.3 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify normal transfer to battery power source and retransfer to normal.
- D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 26 51 19

## **SECTION 28 05 13 - TELEPHONE/DATA/CATV COMMUNICATION SYSTEM(s)**

### **PART 1 - GENERAL**

1.1 The Contractor shall provide, install and connect the complete telephone/data system equipment, backboards, conduit, cable tray, j-hooks, wiring and testing as specified herein and shown on the drawings.

#### **1.2 SCOPE OF WORK**

- A. This installation includes the furnishing of labor, materials, and equipment required for the installation of all service, inside station, and riser cables for telephone and data use between distribution frames, and to each station outlet location required by the plans and specifications.
- B. The work shall include but is not necessarily limited to the following:
  - 1. Furnish and install telephone outlets, data outlets, TV outlets, cables, connecting blocks, backboards, conduits, mounting brackets and associated hardware for bundling, racking and cross-connecting as required.
  - 2. Furnish and install one (1) 1" C from each tele/data outlet concealed up wall to above ceiling. Turn conduits 90° and extend conduit to accessible ceiling space. Provide nylon bushings at ends of conduits.
  - 3. Furnish and install two (2) 4-pair EIA - Category 6a UTP telephone/data station cable to each tele/data outlet shown on the drawing and specified herein. Coil 36" of spare cable (for each cable installed) and secure loop at quarter points of the loop. Extend cables to respective termination point(s). Cables shall be plenum rated where installed in plenums.
  - 4. Furnish and install duplex EIA/TIA 568A, 8 pin 4-pair modular RJ45 data jacks at each telephone/data outlet shown on drawings as specified herein. Color of each jack shall comply with owner's color-coding requirements. Verify color coding requirements in writing with owner prior to purchasing jacks.
  - 5. Furnish and install 6-position modular type wall outlets for all telephone/data shown on the plans. Color of wall outlets shall match color of wall devices and shall be selected in shop drawings.
  - 6. Furnish and install grounding and ground bars as shown on the drawings and as specified. Refer to specification section "Grounding" and to details for additional requirements.
  - 7. Provide and install all required pigtails to Type 110 blocks and terminate each end of the multi-pair station service cables. Copper phone cables only.
  - 8. Furnish and install on the plywood wall backboards all type 89 brackets and Type 110 terminal blocks as shown on the drawings and specified herein for proper termination of the wiring. Copper phone cables only.
  - 9. Furnish and install type 184 binder post as required on backboards. Copper phone cables only.
  - 10. Furnish and install two (2) 4" telephone service entrance conduits each with three

- (3) 1-1/4" innerducts from main telephone equipment room to property line. Refer to site plan
11. Furnish and install Two (2) 4" telephone service entrance conduits each with three (3) 1-1/4" innerducts, from main CATV equipment room to property line. Refer to site plan.
12. Install 1-RG6 plenum rated quad shield coax cable from video receivers to each TV outlet and terminate as required on each end.
13. Contractor shall submit an installation color coding, labeling and testing plan for each floor prior to commencing work.

### 1.3 APPLICABLE DOCUMENTS

- A. The following current issues of rules and regulations shall apply to this scope of work:
  1. EIA/TIA 568, 569, 570, 606, TSB36, TSB40
  2. Building Industry Consulting Service (BICS)
  3. Telephone Standards Handbook GHB-155
  4. Planning Handbook CHB-156
  5. Design Handbook CHB-157
  6. REA Construction and Installation Manuals
  7. REA Specification PC4 for Acceptance Tests
  8. List of Materials Acceptable for use on telephone systems of REA borrowers
  9. National Electric Code (NEC)
  10. State and Local Codes
  11. Telco System Practices
  12. UL

### 1.4 GENERAL REQUIREMENTS

- A. Installation costs including all necessary materials, cables, closures, bridging clips, splice materials, and terminations are to be the responsibility of the Contractor.
- B. Cables routed above the drop ceiling and where not installed in conduit shall be supported to the structure utilizing "J" hooks. Cables are not allowed to rest on the ceiling tiles nor building steel. Maximum clearance to other electrical systems shall be maintained.
- C. All cables, wires, and equipment shall be securely and neatly installed. Inside routings shall be installed parallel and perpendicular to existing structural lines and members.
- D. All cables, wires, and equipment shall be firmly held in place. Fastening and support shall be adequate to support their load with ample safety factors.
- E. The Contractor shall be responsible for replacing, restoring, or bringing to original condition any damage to floor, ceilings, walls, furniture, grounds, pavement, etc., caused by his personnel and operations. Contractor shall restore any damage or disfigurements at his expense.

- F. Cables shall be continuous; no splices will be allowed.
- G. The Contractor shall refer to the Construction Phasing Description section of these specifications for additional information and requirements. It is intended that the Telephone and Data Communications System be placed in service and be of beneficial use to the Owner at the completion of each construction phase of the work prior to occupancy by the Owner.
- H. The Contractor shall coordinate all of his work with the Owner's Information Network Department to maintain tele/data service to the old and new systems as may be required. The Contractor will provide all new services as specified and shown on the drawings in a timely manner.
- I. The Contractor shall not interrupt existing tele/data services and systems in any way until new facilities are in place and approval is received from the Information Network Department and the Architect/Engineer.

#### 1.5 SUBMITTALS

- A. Submit to the engineer shop drawings, product data (including cut sheets and catalog information). Submit shop drawings, product data with such promptness and in such sequence as to cause no delay in the work or in the activities of separate contractors. The engineer will indicate approval of shop drawings and product data submitted to the engineer by stamping such submittals "APPROVED" with a stamp. Submitted shop drawings shall be initialed or signed by the contractor, showing the date and the contractor's legitimate firm name.
- B. By submitting shop drawings and product data, the contractor represents that he or she has carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the contractor has checked, coordinated, and verified that information contained within shop drawings and product data conform to the requirements of the work and of the contract documents.
- C. The engineer remains responsible for the design concept expressed in the contract documents as defined herein.
- D. The engineer's approval of shop drawings and product data submitted by the contractor shall not relieve the contractor of responsibility for deviations from requirements of the contract documents, unless the contractor has specifically informed the engineer in writing of such deviation at time of submittal, and the engineer has given written approval of the specific deviation. The contractor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the contractor in writing, and specifically approved by the engineer in writing.
- E. The engineer's approval of shop drawings and product data shall not relieve the contractor of responsibility for errors or omissions in such shop drawings and product data.
- F. The engineer's review and approval, or other appropriate action upon shop

drawings and product data, is for the limited purpose of checking for conformance with information given and design concept expressed in the contract documents. The engineer's review of such submittals is not conducted for the purpose of determining accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the contractor as required by the contract documents. The review shall not constitute approval of safety precautions or of construction means, methods, techniques, sequences, or procedures. The engineer's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

- G. Perform no portion of the work until the engineer has approved the respective submittal. Such work shall be in accordance with approved submittals.
- H. Submit shop drawings and product data as a complete set within thirty (30) days of award of contract.
- I. For initial submission and for re-submission required for approval, submit one (1) electronic copy of each item. Make reproductions as required for your use and distribution to subcontractors. Reproduction of documents will be at contractor's expense. Illegible submittals will not be checked by the engineer.
- J. General: Submit the following:
  - 1. Bill of materials, noting long lead time items
  - 2. Project schedule including all major work components that materially affect any other work on the project
- K. Shop drawings: Submit the following:
  - 1. Backbone (riser) diagrams.
  - 2. System block diagram, indicating interconnection between system components and subsystems.
- L. Product Data -- Provide catalog cut sheets and information for the following:
  - 1. Wire/Cable.
  - 2. Outlets, jacks, faceplates, and connectors.
  - 3. Terminal blocks and patch panels.
  - 4. Enclosures, racks, and equipment housings.
  - 5. Over-voltage protectors.
  - 6. Splice housings.
  - 7. Fiber optic cable

## 1.6 QUALITY ASSURANCE

- A. Commscope cabling systems, Hubbell Premise Wiring Cat 6 Cabling, and Com Tran Cable  
- Signamax connectivity are approved for the work of this section.
- B. The contractor shall be an authorized Manufacturer's cabling system contractor.

- C. The contractor shall have worked satisfactorily for a minimum of five (5) years on systems of this type and size and be currently operating service organization within 50 miles of project site.
- D. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.
- E. Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the owner and engineer/designer.

## 1.7 WARRANTY

- A. Unless otherwise specified, unconditionally guarantee in writing the materials, equipment, and workmanship, of all cabling system components, for a period of not less than twenty- five (25) years from date of acceptance by the owner.
- B. Transfer manufacturer's warranties to the owner in addition to the General System Guarantee. Submit these warranties on each item in list form with shop drawings. Final payment shall not relieve contractor of these obligations.
- C. Installation costs including all necessary materials, cables, closures, bridging clips, splice materials, and terminations are to be the responsibility of the Contractor.
- D. Installer Qualifications:
  - 1. The Data Cable System Installer shall be licensed and shall meet all applicable regulations of the local and state authorities insofar as they apply to this type of system. The proposer shall be a firm normally employed in the low voltage and data cabling industry and shall provide a reference list of ten (10) large-scale projects and contact names confirming successful Category 6 premises wiring system installations.
  - 2. The Installer shall be a local area, integrator of the manufacturer's product and must provide the manufacturer's maximum available warranty on the entire system. The contractor's certification must have been obtained and held within 75 miles of the project's location.
  - 3. The installing contractor must have a full-time employed RCDD (Registered Communications Distribution Designer) on staff. Current RCDD certification shall be provided in the product submittals.
  - 4. All individuals must be employees of the certified installer and at least 25% of the installing staff shall have undergone a training class given by the manufacturer. Current certification indicating the successful completion of the training course shall be available upon request at the project and submitted in the contractor's product submittals.

## PART 2 - PRODUCTS

### 2.1 MATERIAL SPECIFICATIONS

A. Inside Unshielded Twisted Pair (UTP)

1. All unshielded twisted pair requirements for use shall meet EIA Category 6a specifications (plenum rated when installed in plenum spaces).
  - a. NEC
  - b. UL
  - c. ANSI/ICEA Publication S-80-576
  - d. EIA/TIA 568, 569, 570, 606, TSB 36, TSB 40
2. Multi-pair Riser Cables
  - a. Cables from the MDF shall be further distributed to each of the other closets and terminated on 110 block in the IDFs there. The intra-building inter-IDF cables shall be of the multi-pair type, conforming to or exceeding the following EMMA 568 physical specifications of CAT 6a physical specification.
3. UTP Patch Cords
  - a. EIA Category 6a UTP patch cords (8' in length) shall be supplied at each wall outlet for each jack installed. At the MDF's and IDF's, patch cords shall be terminated at both ends in 4-pair Type 110 or equivalent connectors for plugging onto the type 110 or equivalent cross-connect panels, IDFs and MDFs. The other patch cords shall be terminated in 8 position modular male connectors at both ends conforming to FCC Part 68 Rules, Subpart F. The ends shall be wired in accordance with EIA/TIA 568B.
4. UTP Termination Wall Plates
  - a. The four-pair horizontal cables shall be terminated on 6-position modular duplex (two) outlets meeting EIA specifications for EIA Category 6a UTP and configured in compliance with T56B. The outlets shall be in compliance with FCC Part 68 Rules, Subpart F. The outlets with integrated or separate cover plates shall be installed in single standard electrical wall boxes. The data termination shall allow keyed connectors. The termination of wires shall be by the insulation displacement method equivalent to type 110 and shall require the use of the same punch down tool as the UTP termination blocks specified below.
  - b. Jacks shall allow the insertion of 4 and 6 pin plugs as well as 8 pin plugs or RG6 - Coax connectors. Metal faceplates specified for all wiring devices. Each faceplate shall have provisions for inserting colored tabs to provide use identification for each jack
5. UTP TERMINATION BLOCKS
  - a. At the MDF and IDF closets, all UTP cables shall be terminated on rack mounted two (2) "U" 48 -port patch panels and terminating blocks meeting EIA/TIA 568 specifications for EIA Category 6a UTP. These terminating blocks shall be used for MDFs, IDFs and all UTP cross-connect requirements. They shall allow termination of cables as well as the capability of connecting pre-assembled single pair and composite 4-pair patch cords. Termination blocks to be used for terminating outside plant cables shall be equipped with gas discharge protection units.

- b. The blocks shall be equipped with designation strips and color coded for terminating sets of four pairs of wires in accordance with ICEA specifications.
  - c. Cable tie wraps shall be included to neatly route, store and organize the termination cables.
- 6. **INSIDE FIBER**
  - a. All fiber optic cables shall comply with the FDDI specifications published in ANSI Standard. The cables shall also comply with EIA and the FOTP specifications. The fibers in the cable shall conform to the industry standard color coding as specified by EIA. The outer jacket shall have markings indicating that it is a fiber optic cable. Other markings shall be core size and mode.
  - b. Unless specified otherwise, all fiber optic cables shall be a minimum of twelve (12) strands.
  - c. Fiber optic cable shall be tight-buffered riser cable, multi-mode, OM 3, complete with flame retardant jacket.
  - d. Cables shall be NEC OFNR listed and compliant to UL-1666, CSA FT-4, and ICEA S-83-596 standards.
- 7. **FIBER CONNECTORS**
  - a. All fiber optic cables shall be terminated on connectors installed on rack mounted patch panels. The connectors shall be of the Type LC as defined in the EIA 568 or ANSI FDDI standards, constructed of ceramic or metal/ceramic materials. Plastic connectors shall not be used.
  - b. The connector design shall incorporate strain relief such that it can withstand pulling, bending or twisting of the cable during installation and removal without affecting its operating characteristics.
  - c. The connectors shall conform to all applicable EIA specifications for attenuation, durability, tensile strength, thermal shock, temperature cycling, humidity, impact, etc.
  - d. Provide and install all fiber patch cords complete with LC connectors at both ends. Patch cords shall be 3-meters in length.
- 8. **TYPE LC TERMINATING OUTLETS**
  - a. The connectors and adapters shall conform to specifications as outlined for connectors.
- 9. **FIBER OPTIC SPLICES**
  - a. All fiber optic cables shall be installed in continuous lengths without splices. If splicing is required for extra-long distances, the splices shall be constructed by fusion and offer an attenuation of no more than 0.2 dB per splice. Mechanical splices are not permitted. All splices shall be stored neatly in splice boxes that allow easy access for maintenance and testing.
- 10. **FIBER TERMINATION PANELS AND ADAPTERS**
  - a. The fiber optic cables shall be terminated in Type LC connectors. The terminated fibers shall be inserted in Type LC or equivalent fiber optic couplings /adapters/barrels mounted on rack mounted termination panels/enclosures. The panels shall be of metal construction with the capability of neatly storing excess fiber lengths and providing protection from dust and dirt. The panels shall allow ease of access to and maintenance of fibers.



- b. The panels shall allow cables to be installed and stored such that they do not alter the attenuation of the cables (as may happen when the fibers are tightly coiled or the fiber is excessively bent at the connector strain relief). The adapters shall be metal, of the same manufacture as the connectors and shall introduce a loss of no more than 0.1 dB when two connectors are installed in it.
- 11. EQUIPMENT RACKS
  - a. Each closet shall be equipped with an EIA standard heavy-duty steel 4- post 19-inch equipment racks. Each rack shall be free standing with holes for anchoring it to the floor. They shall be 72 inches high and tapped with mounting holes of 19 inches in width. Provide vertical wire management system on each side of the rack.
- 12. UTP CABLES AND PATCH CORDS COLOR CODING
  - a. Wireless access points - white.
  - b. All other ethernet - blue.
- 13. TELEPHONE SYSTEM
  - a. Contractor shall provide and install two (2) CAT 3 UTP cables from the AT&T service point in the MDF to each elevator machine rooms. Terminate on wall plates in machine rooms as specified.

## PART 3 - EXECUTION

### 3.1 PAIR IDENTIFICATION

- A. The following room recording procedure shall be completed after each wire or cable has been pulled:
  - 1. Terminations: Telephone station cables, CATV station cables and data station cables shall be tagged at backboards with cable tags indicating telephone or data and marked with room number to which it is connected. In rooms where more than one jack exists, the jacks are to be numbered sequentially, and indicated on the cable tag. The outlet number shall also be indicated on the faceplate of the jack.
    - a. Each pair terminated shall be legibly labeled on the terminal blocks according to the room number and jack with which it is associated.
    - b. Each station wire shall be plainly marked at its backboard end with the room number to which it is connected and terminated on the Type 110 termination blocks.
    - c. All cables will be legibly and permanently numbered at each end. String tags are not acceptable.

### 3.2 CROSS CONNECTIONS

- A. At the backboards, Contractor shall cross connect all pairs from each station cable designated for telephone and/or data use to an incoming pair of the riser cable designate for telephone and/or data use. The cross connection of these pairs should provide four (4) continuous pair from each data outlet and one (1)

continuous blue/white pair from each telephone located on that floor. Contractor shall label each pair on the Type 110 terminal according to the numbering scheme.

### 3.3 MDF LAYOUT AND CABLE DISTRIBUTION

- A. The MDF and IDF are constructed of a combination of a backboard on which shall be mounted to type 110 cross-connect blocks and 4-post rack. Provide a minimum of ten feet spare cable for each run coiled on wall (see detail).

### 3.4 UTP NETWORK

- A. The UTP network consist of the following elements:
  - 1. Outside Plant
  - 2. Inside Plant - Riser and Horizontal
  - 3. MDFs
  - 4. IDFs
  - 5. Wall Plates
  - 6. Patch Cables

### 3.5 CABLE INSTALLATION

- A. The contractor shall optimize cable utilization by designing splice points. All cable splices and cable routed through manholes shall be supported on cable racks.

### 3.6 INSIDE

- A. The cables in the risers and closets shall be neatly bundled and tie wrapped. Cable trays shall be provided and installed where necessary, especially between the backboards and equipment racks, and the backboard and the horizontal pathways. Cables traversing the vertical paths shall be anchored to the wall. The method and means of running horizontal cable distribution will vary. Each duplex wall outlet shall have a conduit that runs in the wall from that outlet to the wire closet. Thus, the 4-pair horizontal cable runs shall emanate at the wall outlets, run along the wall conduit, and terminate at the voice or data patch panel in the wire closet.
- B. All cables shall be labeled and color coded in accordance with the EIA 606 standard.

### 3.7 HORIZONTAL RUNS

- A. The wall outlets are of three types: voice, data, and CATV. The voice outlets shall be connected to the voice cross-connect panels in the wire closets. The data outlets are identified by the keyed slot and they shall be connected to the data cross-connect panels in the wire closets. The voice and data cross- connect panels are so identified on the closet drawings. The wall outlets shall be wired in accordance with EIA T568B configuration. At each wall outlet, 18 inches of wire shall be allowed spare for future changes.

- B. Since the cables to be terminated shall be of EIA Category 6a quality, all terminations shall ensure minimum of untwisting at the connections. The length of wire shall be untwisted only to the extent necessary for making the connection. Both the cross-connect panels and the wall outlets are of type 110. These allow the twists to be maintained to the point of termination. Also, the cable slots between the index strips provide space to maintain cable shield to the point of termination.
- C. All terminations on the cross-connect panels shall be labeled and color coded in accordance with industry standards as specified by EIA. All terminations, cables and panels shall be identified and labeled in accordance with EIA 606.

### 3.8 RISER CABLES

- A. The individual cable wires shall be installed in accordance with the method and color coding described under Installation and Test Instructions.
- B. The terminations on the central IDF shall be identified to indicate the MDF connections and the floor connections, both with their own sequential numbering scheme that corresponds with the other end of the cable and also indicated at the location of the other end of the cable. The terminations on the individual floor IDFs shall identify the position on the MDF.

### 3.9 TESTING

- A. All conductors in every cable shall be tested end-to-end to prove that they meet the cable specifications described in EIA standards and this document. The tests shall be conducted in the presence of a Telecommunications Specialist. All tests shall be completed first before any corrective action is taken. Corrected conductors shall be tested again. The Telecommunications Specialist reserves the right to request that the conductors passing the previous tests be tested again after corrective action has been taken on the faulty conductors. Conductors not passing the tests shall also be documented together with the corrective action taken. Test results shall be documented and supplied before the installation is considered for acceptance.
- B. The following tests shall be conducted as a minimum:
  - 1. Compliance with color coding
  - 2. Tip and ring polarity
  - 3. Neatness of cable routing and tie downs
  - 4. Continuity
  - 5. Shorts, grounds and opens
  - 6. Crosses (shorts to other pairs)
  - 7. Rolls (reversed polarity)
  - 8. Splits

### 3.10 ACCEPTANCE TESTING

- A. When the Contractor has completed all cable installation and termination, and he is ready for testing, he shall inform the Architect/Engineer of the intent. The

Architect/Engineer shall assign the Telecommunications Specialist who shall monitor the Contractor testing. The Architect/Engineer has the authority to accept or reject any test and request, and, at his discretion, complete retesting of any portion of the plant if there are an unreasonable number of pairs not passing tests indicated above. The Architect/Engineer may request the Contractor to replace any portion of the plant if the tests indicate faulty or improper installation, or numerous repairs are necessary to pass the tests. The plant shall be accepted by the Architect/Engineer after the Contractor has demonstrated that all the pairs have passed all the tests, all the tests have been documented, the plant is labeled and recorded, and all plant records have been provided in accordance with the requirements of the Documentation Sub-Section later in this document. The Contractor shall comply with any and all warranties required by the general contract agreement with the Architect/Engineer.

### 3.11 RECEIVING FIBER OPTIC CABLES

- A. Before commencing installation, the Contractor shall inspect and test the cables on the reel. The reels shall be accompanied by manufacturer's test report for that particular glass strand and cable indicating such parameters as the attenuation and bandwidth. The Contractor shall at a minimum perform attenuation, break/kink and length verification tests on each strand on the reel with the aid of an OTDR. A printout of the test for each fiber shall be generated and submitted for records. A five-foot section of the cable shall be stripped back and inspected for consistency of manufacture of the jacket, buffer, plastic coating, etc. An inspection and test report shall be provided. Installation shall only proceed after the test documentation has been submitted and the cables have been accepted for installation by a telecommunication specialist.

### 3.12 INSTALLATION OF FIBER OPTIC CABLES

- A. The installation plan shall describe the approach that the Contractor plans to take in installing the fiber optic cables. Some of the typical factors are:
  - 1. Supervisory and technical staff contingent and qualifications
  - 2. Testing the ducts before installation
  - 3. Use of mechanical devices
  - 4. Pulling Force
  - 5. Manhole organization - laying on cable racks and loops of extra cable, etc.
- B. All outside fiber optic cables shall be installed in inner ducts and prominently labeled with "caution, glass fiber cables" or equivalent, at six-foot intervals wherever the cables are exposed to view. Inside cables shall be installed in inner ducts only where installation is in conduits. Open trays do not require inner ducts. Unwound cables shall be placed in figure 8 configurations when they are not on the reels. When a cable is installed, the pulling tension shall be minimal, less than the manufacturer's recommended tension. The cable on the reel shall be unwound such that there is no tension on the cable. The cable shall either be unwound manually, or by any mechanical means that turns the wheel as opposed to pulling the cable. The cable shall be hand-fed over or around any curves, bends or edges without scrapes or bends in the cable. Strain reliefs or supports shall be provided where necessary, such as in manholes or vertical risers.

- C. At each end of the cable a minimum of ten feet of service loop cable shall be allowed for termination and future use. All excess cable shall be neatly stored out of harm's way.

### 3.13 TERMINATIONS OF FIBER OPTIC CABLE

- A. Both single mode and multi-mode-cables are to be installed. Both these types of cables shall be terminated in LC type connectors. However, the two cable types shall be connected on separate fiber patch panels. Proper procedures shall be followed and the right tools used for terminating the fibers in the connectors. Below are examples of precautions and procedures which shall be conformed to:
  - 1. The tool used for stripping the fiber shall conform to the size of the fiber being stripped and shall leave no nicks on the fiber; the stripping shall be effortless and, for example, not require looping of the fiber around the finger for gripping.
  - 2. If crimping is required, the appropriate size apertures on the tool shall be selected.
  - 3. The jacket material remaining after stripping shall be removed by dissolving in chemicals and not by scraping.
  - 4. If the connector required adhesives or epoxy for fastening the fiber to the connector, the material shall be injected in the connector such that it oozes out, displacing all the air from the space to be occupied by the fiber.
  - 5. While seating the fiber in the adhesive filled connector, no air bubbles shall be introduced, such as by inserting and re-inserting the fiber. The fiber protruding from the connector ferrule shall have a small bead formed at its base.
  - 6. The scribe tool used for preparing the excess fiber for removal shall be of high quality and sharp so as not to shatter the glass fiber. The scribed fiber shall be pulled rather than snapped.
  - 7. Heat guns or hot-air blowers shall not be used for curing.
  - 8. Heat shrink tubing shall not be used.
  - 9. A minimum of three types of polishing paper shall be used (changing them often).
  - 10. Polishing shall be performed using the figure 8 routine, creating a spherical polished end profile; a recessed profile shall be rejected.
  - 11. The quality of the polish end shall be inspected using a microscope with a minimum magnification of 200x.
  - 12. All finished terminations shall be covered with boots at all times; similarly, all adapters shall also be covered with boots.
  - 13. Strands of fiber from loose tube cables shall be sheathed in protective fan-out tubing or spiral from the point the fiber leaves the cable to the point where it is terminated on a connector. All gel or waterproofing compounds shall have been cleaned off.
  - 14. The terminations shall be sequentially numbered in synchronization with the color code. The terminations and cables shall be labeled to clearly describe the location at the other end

### 3.14 TESTING OF FIBER OPTIC CABLE

- A. All tests shall be conducted at 1300 mn.
- B. The cable shall be tested on the reels with the OTDR before beginning installation.
- C. The fibers shall be tested with the OTDR after the cables have been pulled and the ends dressed for termination. A paper trace of the test shall be provided for each fiber. Evidence of kinked or otherwise damaged fibers shall be cause for replacement of the entire cable.
- D. Termination of the fiber on connectors shall only commence after OTDR traces have been approved by the Architect/Engineer and the cable accepted for termination. The terminated fibers shall be tested using the power meter. The OTDR - and power meter tests shall be performed from both ends using calibrated adapters and connectors.
- E. Reference measurements of the power receivers shall be checked frequently. Any deviation of 0.1 dB or more shall be cause for retesting the fibers that were tested with that reference.
- F. All test equipment, especially the OTDR and the power meter shall have been calibrated by the manufacturer or an accredited test facility within six months prior to beginning the tests on site.
- G. Acceptance Testing. When the Contractor has completed all cable installation and termination, and he is ready for testing, he shall inform the Contracting Officer of the intent. The Contracting Officer has the authority to accept or reject any test and request, and at his discretion, complete retesting of any portion of the plant if there are an unreasonable number of fibers not passing tests indicated above. The Contracting Officer may request the Contractor to replace any portion of the plant if the tests indicate faulty or improper installation, or excessive re-work is necessary to pass the tests. The plant shall be accepted by the Contracting Officer after the Contractor has demonstrated that all the fibers have passed all the tests, all the tests have been documented, the plant is labeled and recorded, and all plant records have been provided in accordance with the requirements of Documentation, Section 3.4 later in this document. The Contractor shall comply with any and all warranties required by the general contract agreement with the Contracting Officer.

### 3.15 GROUNDING

- A. The buildings shall be equipped with central point grounding schemes. A master ground bar shall be installed at the MDF. Ground window bars shall be installed at the IDF in every other closet. All cables with metallic elements and all metallic hardware shall be grounded in accordance with REA Section 810 and EIAMA PN-2327 grounding specifications for telecommunications.

### 3.16 DOCUMENTATION

- A. The Contractor shall provide two sets of documents. One set shall provide a

record of all the tests conducted on cables, terminations, etc. Another set shall depict all the telecommunications wiring and cabling installation, within and to the building.

### 3.17 TEST DOCUMENTATION

- A. Test records shall be provided for the following tests:
  - 1. UTP, Terminations
    - a. Manufacturing test results
    - b. Outside plant cables
    - c. Riser cables
    - d. Horizontal cables
  - 2. Fiber
    - a. Manufacturing test results
    - b. Outside plant fibers - OTDR before and after installation
    - c. Fiber terminations - power meter tests

### 3.18 RECORD DOCUMENTATION

- A. After all installations have been completed and tested, the Contractor shall provide records of the installation in accordance with EIA/TIA Standard 606. The records shall be required in hard copy format printed from a software such as Cable Management Systems by Microtest (CMS). CMS is a commercially available off-the-shelf software designed specifically for cable installation records. The Contractor shall supply the software and the records using the software to one FWS technician.
- B. As described in the EIA standard, the following types of records shall be supplied:
  - 1. Fiber, voice and data terminations located in work areas, telecommunications closets, equipment rooms and entrance facilities.
  - 2. Telecommunications media between terminals (horizontal distribution).
  - 3. Pathways between terminations that contain the media.
  - 4. Spaces where terminations are located.
  - 5. Bonding/grounding as it applies to telecommunications.
- C. All the elements of the telecommunications infrastructure shall be identified and labeled by a code. The coding method to be used shall be as specified in the EIA 66 standard. On the following page is a representative list reproduced from the standard (xxx denotes a numerical designation).

| CODE   | DESCRIPTION       |
|--------|-------------------|
| BCxxx  | Bonding Conductor |
| BCDxxx | Backbone Conduit  |
| Cxxx   | Cable             |
| CBxxx  | Backbone Cable    |

|        |  |
|--------|--|
| CDxxx  | Conduit                                  |
| CTxxx  | Cable Tray                               |
| ECxxx  | Equipment (bonding) conductor            |
| EFxxx  | Entrance Facility                        |
| ERxxx  | Equipment Room                           |
| Fxxx   | Fiber                                    |
| HHxxx  | Hand Hole                                |
| ICxxx  | Intermediate Cross-Connect (IDF)         |
| Jxxx   | Jack (Outlet)                            |
| MCxxx  | Main-Cross-connect (MDF)                 |
| MHxx   | Man hole or maintenance hole             |
| PHxxx  | Pull Box                                 |
| Sxxx   | Splice                                   |
| SExxx  | Service Entrance                         |
| SLxxx  | Sleeve                                   |
| TCxxx  | Telecommunications Closet                |
| TGBxxx | Telecommunications grounding busbar      |
| TMGB   | Telecommunications main grounding busbar |
| WAXxx  | Work Area                                |

### 3.19 MAINTENANCE CONSIDERATIONS

- A. The cable installation shall be installed to maximize the safety, maintainability, and performance effectiveness of maintenance personnel, and shall minimize demands upon skills, training and manpower. Splices/terminations shall be placed and supported so as to maximize the efficiency and ease with which it can be maintained and shall ensure accessibility.

### 3.20 CABLE TESTS

- A. Contractor shall perform testing of all pairs for each cable installed as directed by these specifications. Post construction cable acceptance tests consist of conductor continuity tests, and conductor insulation resistance tests. These tests assure that the cable has been terminated properly and has not been damaged during construction. An Owner's representative will be required to witness these tests.



- B. Each cable pair shall be tested for shorts (T to R and T&R to ground), continuity, and loop resistance. Maximum loop resistance from the main telephone/data panel to each jack shall be within 5% of the calculated value based on the actual length of cable installed, and the loop ohms/1000 ft. for copper conductors.

### 3.21 DEFECTIVE CABLE PAIRS

- A. The vendor shall test all cable pairs and shall record, on the pair assignment record, the nature of the defect for each pair found to be defective and remedies used to clear the defect. In order for the cable distribution system to be considered acceptable, there shall be no defective pairs in any cable. Any cable having defective pairs shall not be used and shall be replaced at Contractor's expense.

### 3.22 INSPECTIONS

- A. Routine on-site construction inspections by the Architect/Engineer and/or an Owner's representative will involve trips to the complex to inspect construction, so as to assure adherence to standard construction practices. The number of such inspections will be at the Architect/Engineer's discretion.

### 3.23 ACCEPTANCE

- A. The project shall be considered acceptable based upon the following:
  - 1. Contractor has furnished and installed all equipment and materials and performed all work in accordance with these specifications.
  - 2. Contractor has successfully completed all the required testing assuring compliance with the required specifications.
  - 3. Contractor has removed all trash and debris by contractor from the area and restored site to original condition.
  - 4. Contractor has submitted the required documentation to state officials.

END OF SECTION 28 05 13

## SECTION 28 31 11 – FIRE ALARM SYSTEM WITH VOICE EVACUATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes fire alarm systems.
- B. Definitions:
  - 1. FACP: Fire alarm control panel.
  - 2. LED: Light-emitting diode.
  - 3. Definitions in NFPA 72 apply to fire alarm terms used in this Section.
- C. System Description:
  - 1. Noncoded, Analog addressable system; multiplexed signal transmission dedicated to fire alarm service only.
- D. Performance Requirements:
  - 1. Comply with NFPA 72 latest edition or edition enforced by state or local code authority.
  - 2. Fire alarm signal initiation shall be by one or more of the following devices:
    - a. Manual stations.
    - b. Heat detectors.
    - c. Smoke detectors.
    - d. Automatic sprinkler system water flow.
  - 3. Fire alarm signal shall initiate the following actions:
    - a. Alarm notification appliances shall operate continuously and be synchronized as required per code.
    - b. Identify alarm at the FACP and remote annunciators.
    - c. Transmit an alarm signal to the remote alarm receiving station.
    - d. Shut down heating, ventilating, and air-conditioning equipment over 2000 cfm.
    - e. Record events in the system memory.
  - 4. Supervisory signal initiation shall be by one or more of the following devices or actions:
    - a. Operation of a fire-protection system valve tamper.
  - 5. System trouble signal initiation shall be by one or more of the following devices or actions:
    - a. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
    - b. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.

- c. Loss of primary power at the FACP.
  - d. Ground or a single break in FACP internal circuits.
  - e. Abnormal ac voltage at the FACP.
  - f. A break in standby battery circuitry.
  - g. Failure of battery charging.
  - h. Abnormal position of any switch at the FACP or annunciator.
6. Resetting of other systems:
- a. Resetting of duct detectors shall be from the panel.

## 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  - 1. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
  - 2. Device Address List: Coordinate with final system programming.
  - 3. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
  - 4. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
  - 5. Batteries: Size calculations.
  - 6. CAD drawings with device locations, device ratings, cable routing, cable size/type, etc. indicated on floor plans.
  - 7. All shop drawings are to be electronic in nature and submitted in PDF form. Paper shop drawings will not be reviewed.
- C. Field quality-control test reports per NFPA 72.
- D. Operation and maintenance data.

- E. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Complete all required form. Contractor is responsible for all required fees. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review. All drawings shall be done in AutoCAD R14 format or newer.
- F. All fire alarm drawings are to be submitted digitally. Fire alarm devices with any notation are to clearly stand out from the floor plan by using a bolder line width contrasting a screened floorplan. Devices and notation are to be proportionally sized to the scale of the drawing. Fire alarm devices only are to be indicated on drawings, drawings are not to be shared with electrical devices or any other discipline.
- G. Documentation:
  - 1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
  - 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
    - a. Electronic media shall be provided to Architect and authorities having jurisdiction.

### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project and shall be supervised by a Nicet Level III Supervisor.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. FACP and Equipment:
    - a. Silent Knight
    - b. Fire Lite.

2. Wire and Cable:

- a. Comtran Corporation.
- b. Helix/HiTemp Cables, Inc.; a Draka USA Company.
- c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
- d. West Penn Wire/CDT; a division of Cable Design Technologies.
- e. Coleman Cable.

2.2 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864 listed.
2. Analog addressable control circuits for operation of mechanical equipment.
3. System shall be sized for the number of points indicated plus (20) twenty percent spare.
4. System shall be non-proprietary. Proprietary panels or devices shall not be allowed in system.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, two line(s) of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Circuits:

1. Signaling Line Circuits: NFPA 72, Class B, Style 4.
2. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
3. Circuits shall be configured with loop isolators.
4. Actuation of alarm notification appliances, annunciation, and elevator recall shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

E. Elevator Controls: Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.

1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

- G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.
1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
  2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
  3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter. The system shall be capable of communicating and telephone lines.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory signal and supervisory and digital alarm communicator transmitter and digital alarm radio transmitter shall be powered by the 24-V dc source.
1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
  1. Power supply shall have a dedicated fused safety switch or circuit breaker for this connection at the service entrance equipment. The switch box or circuit breaker shall have red marking identify it with "FIRE ALARM SYSTEM POWER." Where a circuit breaker is the disconnecting means, an approved breaker locking device shall be installed.
  2. Provide surge protection on all 120 volt power serving fire alarm equipment.
- K. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
1. Battery and Charger Capacity: Comply with NFPA 72.
  2. Provide surge protectors on all circuits.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.
- M. Voice/Alarm Signaling Service: A central emergency communication system with supervised microphone, preamplifier, amplifier, and tone generator provided in a separate cabinet or as a special module that is part of the FACP.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.
  - a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
  - b. Programmable tone and message sequence selection.
  - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
  - d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.
2. Notification-Appliance Circuits: NFPA 72, Class B.
3. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

## 2.3 MANUAL FIRE ALARM PULL STATION

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. 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 an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
  2. Station Reset: Key- or wrench-operated switch.

## 2.4 SYSTEM SMOKE DETECTORS

- A. General Description:
  1. UL 268 listed, operating at 24-V dc, nominal.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
  3. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
- B. Multi Criteria Detectors:
  1. Minimum of photoelectric and heat.
  2. Sensor: LED or infrared light source with matching silicon-cell receiver.
  3. Photoelectric Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
  4. Thermal detection.

C. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.

D. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

- a. Sensor: LED or infrared light source with matching silicon-cell receiver.
  - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
  3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
  4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
  5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
  6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
  7. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
  8. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

## 2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or rate-of-rise of temperature that exceeds 15 deg F (8 deg C) per minute, unless otherwise indicated.

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.



## 2.6 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly. Factory standard color by Architect (Red or Beige).
- B. Voice/Tone Speakers:
  - 1. UL 1480 listed.
  - 2. High-Range Units: Rated 2 to 15 W.
  - 3. Low-Range Units: Rated 1 to 2 W.
  - 4. Mounting: Flush, semi-recessed, or surface mounted; bidirectional as indicated.
  - 5. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
- C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
  - 1. Rated Light Output: Candela indicated on drawings.
  - 2. Strobe Leads: Factory connected to screw terminals.
  - 3. Where multiple visual notification appliances can be seen from any location, circuitry shall be incorporated for the synchronization of flash rate.
  - 4. Adjustable Strobes-Field selectable from 15cd, 30cd, 75cd, 110cd.

## 2.7 SPRINKLER SYSTEM REMOTE INDICATORS

- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
  - 1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

## 2.9 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall and to a circuit-breaker shunt trip for power shutdown.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated. The contractor shall provide conduit and cable to telephone backboard and make final connections to telephone service.
- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.11 CELLULAR COMMUNICATOR TRANSMITTER

- A. Napco Starlink Fire LTE Commercial or approved equal.
- B. UL Listed.
- C. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically communicates to the central station. When contact is made with the central station(s), the signal is transmitted.
- D. If needed remote antennas shall be installed to allow for communications to monitoring company.
- E. Communicator shall be compatible with the owner's monitoring company.
- F. Communicator shall be powered by the FACP.
- G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

## 2.12 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet and Modbus protocol for connection to building automation system.

## 2.13 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
  - 1. Twisted shielded pair, NFPA 70 Article 760, UL listed as Type FPLP, plenum rated and complying with requirements in UL 1424.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
  - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
  - 2. Line-Voltage Circuits: No. 12 AWG, minimum.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.
- B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- C. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- D. Audible Alarm-Indicating Devices: Install per NFPA 72. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- E. Visible Alarm-Indicating Devices: Install per NFPA 72.
- F. FACP: Surface mount with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

- G. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.
- H. The contractor shall provide the following spare devices at a location determined by the engineer or fire marshal prior to final approval of shop drawings. Contractor shall be responsible for all conduit, wire, battery, cards etc. needed to install these spare devices. Devices not used shall be delivered to the owner as spare. Devices: 6 - horn/strobes (any candela), 4 - pull stations, 4 - smoke detectors, and 4 - control modules.

### 3.2 WIRING INSTALLATION

- A. Install wiring according to the following:
  - 1. NECA 1.
  - 2. TIA/EIA 568-A.
- B. Wiring Method:
  - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable. Cable installed in plenum ceiling spaces shall be plenum rated. Fire alarm cable installed in walls, exposed areas or in inaccessible spaces shall be in conduit. All cable and conduit shall be concealed where possible.
  - 2. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to 1 monitoring function.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to "Basic Electrical Materials and Methods Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM CIRCUIT CONTROL."

### 3.4 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
  - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters.
  - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
  - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
    - a Detectors that are outside their marked sensitivity range shall be replaced.
  - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Provide a minimum of 2 hours of training to the Owner's Representative.

END OF SECTION 28 31 11